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EDITORIAL

HOW DO WE KNOW WHAT WE KNOW?

From the moment that our tiny fingers grasp instinctively at the nearest object with a grip the intensity of which is a vestigial remnant of our arboreal ancestry, we are, consciously or unconsciously, engaged in the acquisition of knowledge.

Some of us accumulate more and some of us less, depending in part upon our contacts and exposures to sources of supply, and to a great extent upon our interest in a subject.

Lack of interest is the principal reason why a greater number of persons are not possessed of a liberal education; for, once given the urge, no handicap can prevent a man from learning all that he can possibly learn about everything in which he is interested, for diversity of interests and breadth of vision are the distinguishing features of a liberally educated man, one conforming to the classic description left by Thomas Huxley.

Every one may be said to be possessed of two kinds of knowledge: that which is obtained at first hand, which might be termed primary knowledge, and that which is acquired from others by hearsay, which may be called secondary knowledge. The proportion of the amount of primary knowledge to the amount of secondary knowledge which any individual may possess is in direct ratio to his interest in fundamental facts and the breadth of his training, but even in the most highly educated individual the amount of secondary knowledge is in great excess of the amount of primary.

Take for example the names of things which are about us and which we see or use every day. How many of us know except by hearsay, whether these are the correct names?

We call a certain tree an oak and another a maple. Is this because we have been told by others that these are the correct names for these respective trees, or have we actually established their identity by a botanical investigation? Very likely the former, and when we come to take a stock account of our knowledge we realize how little we are actually certain about and how much is vague or unidentifiable as to its source.

In education, therefore, the laboratory method of instruction is the only method of imparting primary knowledge, for the lecturer is only a disseminator of secondary knowledge which may have and probably has come to him in the same manner.

There are some departments of learning in which the secondary knowledge necessarily predominates, as in history. There are others in which the knowledge is almost altogether primary as in laboratory physics and mathematics. The sciences stand about midway in the list, for in them both methods of instruction are possible, and it is a sign of progress that laboratory courses are coming to be more and more recognized as absolutely essential in establishing the fundamental principles, without which an individual might as well have no education at all for he has no standards for comparison and is therefore unable to distinguish the true from the false.

Along with the primary and secondary knowledge, which we will assume is correct, whatever may have been its method of acquirement is a lot of misinformation which passes current for knowledge with many who are unable to distinguish between truth and error. It is due to this contamination that so many individuals fall victims to charlatans, for credulity rises in proportion to the lack of sound fundamental knowledge. The age through which we are passing has been aptly termed an age of credulity.

Can we prevent the next generation from falling victims to the same evil? We can if we continue to develop along the sound lines of progress in education that have recently been established. More and better laboratory courses; lectures by men who have acquired their knowldege at first hand and who use abundant illustrative material; and above all, a standard of accomplishment and progress on the part of the student that will insure his being acquainted with the simple facts before he takes up those which are more complex. Not more, but better students should be the watchword of every educational institution.

More primary and less secondary knowledge should be the aim of every teacher. When we can raise the ratio of primary to secondary knowledge and diminish the proportion of misinformation a great result will have been achieved and more of us will be able to understand why and how we know what we know.

C. H. L.

ORIGINAL ARTICLES

CHEMISTRY AS AN AID IN THE DETECTION OF CRIME.*

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In treating this subject, the scope of chemistry must be extended to include several accessory methods, especially some that might be in strict classification assigned to physics. Physicists, however, are but rarely called into consultation in legal actions, except in connection with those concerning patents. Chemists, of course, are also frequently called on to testify in patent litigation, but the present study relates wholly to the service of chemistry and its allied methods to the detection of crimes and misdemeanors. In civilized countries, at the present day, the commission of crime is an offense against the state, rather than against the person. The theory is that the state guarantees to each citizen equal protection of the law, and, therefore, must enforce, against any one who infringes such guarantees, the punishments provided.

Chemistry came early in recognition as an important, in fact, indispensable, aid to the detection of many forms of crime, but especially in the detection of poisons. Toxicology has for a long while been the special field of the chemist. The word, by the way, comes from a Greek work meaning a "bow," the weapon used by primitive man. The connection between a bow and poison lies presumably in the use of poisons on the point of the arrow, and thus "pharmakon toxicon," "arrow poison," came to be applicable to all forms of

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poisons. As chemistry was for many centuries pursued in a somewhat haphazard manner, a systematic treatment of it or of its practical applications was not possible. Notwithstanding the long use of poisons for criminal purposes, the founder of the modern science of toxicology may be considered to be Mathieu J. B. Orfila, a Spaniard by birth, who was born in 1787, the year in which the Convention assembled to frame a Constitution for the United States. His book, "A Treatise on Poisons or General Toxicology," published in French before he was thirty years of age, laid the foundation of a systematic development of the subject.

The great advances made in methods of reseach and in the precision and accuracy of chemical and physical procedures, have given to toxicology a much greater scope and greater exactness, and it will be the purpose of this lecture to indicate some of the features of the present procedures. While the detection of poisons is still one of the main features of the chemist engaged in aiding the police and the courts, other questions of importance have arisen, among which is the detection of blood and the determination of the animal from which derived. The modern control of foods and beverages has multiplied greatly the applications of chemistry, and compelled much research and investigation. Crime of all kinds, from murder to petty theft, manifests a good deal of ingenuity and resource, and it is not left to the chemist to perfect a process and then rest quietly in the employment of it. Offenders of all grades can also employ scientists, and hence the work of the public chemist is a sort of a game of hide and seek. A process for detection of a certain poison or adulterant becomes known; those who have criminal intent can frequently find either a substitute which is satisfactory for their purposes, but does not respond to the tests for the original substance, or they can mask the original substance so that the standard test fails. The chemist may be said to be "still achieving, still pursuing," and he is constantly discarding processes either because better ones are available or because the ingenuity of law-breakers has changed conditions.

The scope of this lecture does not allow of more than a glimpse at the many applications of chemistry in the service of the law, and hence a few instances of striking character will be presented, and even these can only be given brief description.

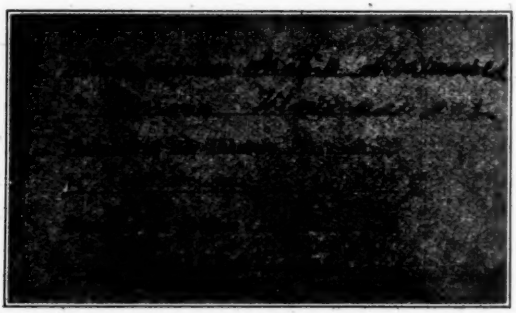
At the present day, the chemist cannot dispense with the use

of the microscope, which though a physical instrument has taken so prominent a place in the chemical laboratory as to have become a part of that equipment. The microscope has long been used in the detection and distinction of blood-stains. For many years a great reliance was placed on the form of the blood corpuscles, which are materially different in the different classes of animals, but for the higher animals, that is, the common domestic and wild mammals, the form (shape) is about the same although some difference in size is noted. The blood of birds, reptiles and fish shows elliptical corpuscles, while those of mammals are round, but since, in cases of blood-stains, it is possible that some common four-footed animal may have been the source of the blood, a specific distinction of human blood is greatly to be desired. For a long while this was impossible, but a test, known as Bordet's test, is now applicable. This usually is carried out as follows: A small amount of human blood deprived of fibrin (the clotting material) is injected into the blood of a rabbit, at intervals of four days, until two fluid ounces have been introduced. After about ten days, the animal is bled, the blood serum introduced into sterile tubes and kept for use. In applying this test some of the solution of the stain is mixed with a minute amount of the prepared serum and the mixture kept at 37° C. If human blood is present, a turbidity will be produced which in a few hours will become a flocculent precipitate. The test liquid prepared as indicated gives no reaction with any of the animals common in temperate climate, but it does react with the blood of some of the manlike apes.

A general test for blood is with tincture of guaiac resin and hydrogen peroxide which gives a blue tint. Hawk has found that if the sample to be tested is boiled for 15 to 20 seconds all materials that stimulate blood are so altered that they no longer give the color, but blood preserves its property. Many years ago a man on trial for murder attempted to account for some blood stains on his clothing by saying that he had been carrying some recently killed chickens, but the corpuscles of the stains showed clearly that they had come from no such source as alleged.

One of the most satisfactory methods of identifying substances is by means of their crystalline form. When the crystals are large, as they commonly are in natural minerals and in substances manufactured in large quantity, inspection with the unassisted eye suf-

fices, but in many cases, crystals are very minute and microscopic examination is needed. At the present time, the appliances for such examinations have been brought to a very high pitch, among other methods being modifications of light. Several such modifications are now familiar. The simplest is making a change in the direction of the light as it falls on the object. In this way differences in the surface are made more evident. Another method is by means of colored screens. Polarized light has been of much value. Recently, much valuable information has been obtained by the use of rays of light that are invisible to the human eye, but which have a strong effect on a photographic plate. Some examples of these methods will now be given.



Erasures made more distinct by using color screen.

Among the substances which have long been used in criminal poisoning is arsenic. This occurs usually as a white powder, somewhat gritty, and but slightly soluble in water and common liquids. Under the microscope it is seen to consist of brilliant crystals showing more or less triangular faces. The size of these crystals differs somewhat according to the method of manufacture. Owing to the slight solubility of arsenic in the fluids of the body, portions of it may remain for hours in the stomach without losing their distinct crystalline form.

In a case tried in Philadelphia many years ago, several grains of arsenic were found in the stomach of a woman, who had died under suspicious conditions. Her husband was tried for poisoning her, and the defense alleged that she had been taking a trituration of arsenic as a complexion improver. Homœopathic triturations of

arsenic were found in the house, but the arsenic in the stomach was in distinct crystals, and it was thus shown that other arsenic had been used. The prisoner was convicted and hanged, and subsequently the attorneys for the defense admitted the truth of the expert's contention.

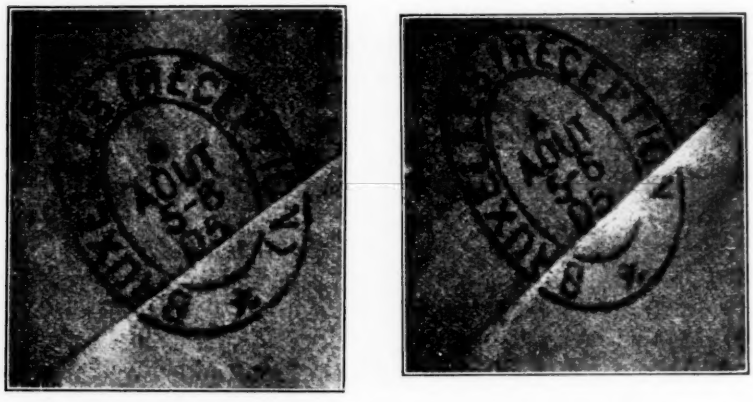
In the Mary Stannard case, tried in Connecticut, the defense alleged that the arsenic found in the stomach was part of that contained in a package that had been bought for killing vermin infesting a barn, but it was shown that the proportion of crystals of a certain kind was very different in the sample from that in the stomach. The testimony, however, in this case did not convince the jury.

The manufacture of chemicals on the large scale may not be carried out in the same way in different establishments, and hence, it is sometimes possible to determine the specific source of a substance. In this manner, it was found a number of years ago that two large establishments in Philadelphia produced distinctly different forms of bismuth subnitrate. There was no evidence that one product was inferior, but merely that some difference in the procedure of manufacture caused the formation of somewhat different crystals.

Adulteration of food and drugs is a very extensive and frequent form of crime. The discovery of such adulterations is now the regular business of hundreds of chemists, and much literature is annually published relating to the subject. In this sketch only a few items can be presented. Naturally, the substitution of cheap materials for dear ones is a common form. In this way cheaper starches, such as corn starch, are substituted for arrow root starch; alum is substituted for cream of tartar in baking powders; vegetable and animal fats are substituted for butter; glucose is substituted for cane sugar. The detection of these and similar adulterations requires an elaborate equipment and a thorough training, and the difficulties of the chemist are seriously increased by the fact that new methods of adulteration are continually being introduced, and old methods abandoned. Sometimes an incidental ingredient that happens to be in the adulterating material and not in the genuine substance may serve as means of detection. As an instance of this may be mentioned the use of agar as gelatinizing material in ice cream. Agar is the tissue of a sea plant found in the Pacific ocean. It forms a jelly with water that does not melt at ordinary summer temperature. It happens to be usually accompanied by numerous diatoms, which

are minute siliceous skeletons, of characteristic form. As the agar and the food material with which it may be associated can be easily destroyed by strong acids, while the skeletons of the diatoms resist such action, it has been at times possible to detect the addition of sugar by detecting the diatoms.

Crimes of various types are connected with forgery and the alteration of documents. Checks are raised, wills and deeds forged and other misuses made of the arts of writing and printing. A good deal of investigation has been bestowed on the methods of detecting such crimes. Several phases may be presented. Attempts are not infrequently made to manipulate documents so as to indicate a much



Postmark on envelope which had been opened and reclosed. Left-hand picture under direct light; right-hand picture under oblique light, showing advantage of the latter method.

earlier date of execution than is the fact. Many years ago one of the political parties in Philadelphia, attempted to secure the naturalization of a large number of aliens by means of forged papers alleged to have been taken out several years previously. To give the appearance of age, the papers were soaked in coffee. This method has been occasionally used. A simple test is the application of a solution of a ferric salt, which, if coffee infusion is present, will produce a black stain. In former times a good deal of stress was laid on the water-marks. These were often somewhat fantastic designs, but in other cases simple designs with dates. The earliest water-mark is very simple and is said to date from about 1300. Of recent years

the introduction of wood pulp and ground wood has given rise to very inferior products, especially for newspapers and cheap books. Sometimes news paper contains very little true pulp and hence early becomes yellow and very brittle.

The detection of such inferior materials is often very important, and chemical and microscopical methods are employed. The several fibres used in paper-making have distinct characteristics and, in addition, ground wood gives distinct colors with certain solutions. The detection of ground wood might serve to show a fraudulent document, since if a deed or other legal document purported to have been drawn at a date previous to the use of such wood was found to contain such material, the fraud would be evident.

The alteration of checks is one of the most serious troubles that business men have. In spite of much ingenuity that has been applied in preventing these frauds, cases are constantly occurring, although it is claimed that lately efficient methods have been devised. In former days merchants were content to write their checks on plain white paper, but roguery is now too common, and checks are printed on safety papers. Photography has been successfully applied to the detection of alterations and forgeries. By the use of color screens and special forms of light, the texture of the paper and the detail of the writing and erasures can be brought out often quite vividly.

The substitution of artificial colors for natural colors, especially in the preparation of fruit juices, syrups, jams, jellies and soft drinks is a very frequent form of adulteration. The methods of detection in these cases are purely chemical, principally by the use of dyeing of woolen or silk fabrics. Natural colors, at least, of the common fruits and flowers, do not dye very firmly, while artificial colors do. For the detection of coloring in milk, butter and other milk products special tests are employed.

The investigation of crime involves several distinct features. The psychologic phases of human action must be taken into consideration, and, in many cases, scientific investigations are not applicable, but on the other hand chemistry and its closely allied sciences are of great use in indicating the exact conditions under which crime has been committed.

It must, however, be borne in mind that the work of the chemist is not always in the direction of positive results, or of securing conviction for crime. In many cases the laboratory fails to solve the

problem submitted, and in others finds results contradictory to those that have been assumed. The world hears less of such cases than of the affirmative ones, but failures are often very instructive. Very often, popular clamor and mistaken inferences lead to investigations which ultimately show that the charges are without foundation, but sometimes the contradiction does not get the currency that the original assertion did. During the late war, statements were made that powdered glass was found in certain food articles supplied to the camps. Naturally, much indignation was aroused, for such admixture could only be the work of a deadly enemy to the nation.

Finger marks of accused person taken respectively from a bottle and from a menu card, showing identity.

The matter was dropped, but the general public has not heard the outcome of the scientific investigation. In at least one case it was found that the material supposed to be powdered glass was really crystals of ammonium magnesium phosphate, formed through some chemical change that had occurred in the materials. In another case a sample of grape jelly was submitted to Dr. LaWall, on account of brilliant particles scattered through it, the person who brought the sample being convinced that these were powdered glass. Analysis showed them to be crystals of cream of tartar, a constant ingredient of grape-juice, which had crystallized out. The client, however, was not satisfied with the analyst's statement until a few of the crystals were dissolved in boiling water.

Chemists who do work for physicians meet with many instances of false claims. Red stains are alleged to be blood; fragments of common stones are submitted as calculi and lots of other fakes are practiced. Those who are engaged in industrial work, such as the analysis of ores and minerals, are constantly meeting with faked minerals, which have been submitted to boost some mining or manufacturing scheme. "Fool's gold" is an old name for an iron-containing mineral which has a bright gold lustre and has deceived many a searcher for mining investments.

[The illustrations are taken from Wolf-Czapek's *"Angewandte Photographie."*]

JOHNNY APPLESEED.*

By J. W. Sturmer, Ph. M.

It is hard to realize—as one passes through Ohio or Indiana, on the way to Cleveland—that this region, a little more than a century ago, was a vast forest, the cherished hunting grounds of the red men. Here for unnumbered generations they kindled their camp fires, erected their wigwams and lived their lives in peace and in tribal warfare, in accordance with their traditions. Whence they came, or when they came, no one knows; history records only the dramatic and tragic episodes of their passing.

The pale face from the distant lands of the rising sun, who came to dispute the red man's exclusive right to his ancestral hunting grounds, was no welcome intruder. But it was with an intense hatred that the Indian contemplated the arrival of the pioneer who came to build a permanent home. For with his axe he felled the trees and made great clearings in the sombre forest. His plow uprooted the familiar flora and prepared the ground for strange grain. His gun exterminated the game. In due course he built roads, linking the clearings. He bridged the streams, drained the swamps, founded villages teeming with strange activities, and indeed changed the very face of nature as effectively as some great physical cataclysm, coming as an act of wrath of the Great Spirit.

* Presented to Cleveland Meeting A. Ph. A. Permission granted for publication prior to appearance in *A. Ph. A. Journal.*

But the influx of these dauntless and marvelously efficient pale-faces, once begun, never slackened. They brought their kith and kin. Their block houses and trading posts soon occupied the strategic positions along the water courses and the Indian saw himself dispossessed of his hunting grounds. He was forced to retreat deeper and yet deeper into the forest, which he did, however, with the determination to exact of the intruders the highest possible price in human blood. Hence it is that the early history of Ohio and Indiana is a record of ambuscades, and massacre, and of the heroic defense of their newly established homes by the early settlers.

Both history and fiction have faithfully portrayed the typical pioneer, as handy with the gun as with his tools of agriculture, a sturdy figure, the advance guard in the great military invasion which conquered the Middle West for the white man.

Yet, when about a hundred years ago, the Indians had planned a night attack upon a settlement a little more than sixty-five miles southwest of where we now sit (Cleveland), the warning was brought by a strange white man who had traversed unarmed the great forest, which beyond gun-shot range of the clearings was a "no man's land," full of lurking dangers; and it was he, who, traveling at night, brought reinforcements from a blockhouse thirty miles distant. A tall, gaunt man, clad in clothing much the worse for wear, the coat having been improvised from a coffee sack, and the mush pot of his meagre camping outfit doing service as a helmet, he must have been an odd figure, even in those unconventional days. But he was a welcome guest at every pioneer's fireside, for he was none other than Johnny Appleseed—Swedenborgian missionary, philosopher, poet, nature lover—a kind of nomadic Thoreau, but with a deep human sympathy, gentle and kindly, whose philanthropy extended to the stranger, and whose altruism contemplated the generations who were to inhabit this newly settled region. He was the pioneer nursery man of the Middle West and the distributor of seeds of medicinal plants brought from the older settlements. As he put it—

"I love to plant a little seed
Whose fruit I'll never see;
Some hungry stranger it may feed,
When it's become a tree."

His real name was John Chapman, and his birthplace, Springfield, Massachusetts. In 1806 he arrived in Ohio, and planted his

first Ohio nursery near the present town of Steubenville. From this point he moved westward and northward, until his plantings formed a chain extending into Northern Indiana. His seedlings and his seeds of herbs were distributed without charge, though he would accept a night's lodging, a meal, or some simple article for his camping outfit. For forty-six years he was a rover along his chain of nurseries, and at the ripe age of seventy-six he died of pneumonia, at a farmer's home, a few miles north of Fort Wayne, Indiana. Nearby, in what is known as Archer's Cemetery, rest his remains. And in Sweeney Park, in the aforementioned city, the Indiana Horticultural Society has erected a memorial to his memory—a granite boulder, worn smooth by its glacial journey from some distant parent rock. Old apple trees grown from the stock provided by Johnny Appleseed, are still bearing fruit, and several may be found in Fort Wayne, near the conflux of the St. Mary and St. Joseph rivers, which form the Maumee. But no one can estimate how many gardens in Ohio and Indiana contain medicinal plants traceable to the seeds which he distributed; and the indigenous flora has to a large degree been replaced in certain sections by his plants of Eastern origin which have since escaped cultivation.

He was no great botanist, and his knowledge of the medicinal worth of plants was rather erratic. Some of the unwelcome weeds, as, for example, the ill-smelling dog fennel, *Anthemis cotula,* now so common in many rural school yards, and on farmland allowed to lie fallow, were disseminated by Johnny Appleseed, with the mistaken idea that he was providing valuable medicine for his fellow man. But as to that, he is far from standing alone when it comes to being in error about the true therapeutic value of plants purported to be medicinal.

John Chapman—Johnny Appleseed—one of the most picturesque figures of the pioneer days of this section, lived a life of peace in an era of Indian wars. When his contemporaries established homes, and accumulated property, he, though a poor man, spent his allotted years in practical philanthropic enterprise. He lead no military expeditions, framed no laws, laid out no towns. Yet who would say that this gentle, eccentric distributor of seeds, and of young apple trees, by his example of outstanding unselfishness, did not leave a profound impress upon the pioneers of this section, just as his curative herbs have spread to replace in part the native flora. Preceding the

country doctor, and the village apothecary, he was literally the pioneer in supplying medicine to the settlers of this region. The history of Ohio and Indiana pharmacy would therefore be incomplete if it did not include some reference to this uncouth but kindly wanderer in the wilderness—Johnny Appleseed.

DETECTION OF DIETHYLPHTHALATE AND PHTHALEINS.*

By Ralph L. Calvert, Ph. G.

Within the past year a tax-free alcohol for use in perfumery has been available. This alcohol is denatured with diethylphthalate, and acccording to Formula 39 B; should contain 2½ gallons of diethylphthalate to every 100 gallons of ethyl alcohol. This denaturant is a colorless, practically odorless liquid, oily in appearance and has a specific gravity of 1.175 at 25° C.; boiling point between 290-297° C. It is readily miscible with alcohol, ether, petroleum ether, and many other similar solvents. It has a very pronounced bitter and disagreeable taste, producing a sense of numbness to the tongue.

In spite of its disagreeable taste, it is a source of temptation to the boot-legger brotherhood, and quite frequently one finds it, quite cleverly disguised in so-called whiskey. It can easily be detected as stated by Dr. A. B. Lyons in an article in the April number of the *Journal of the American Pharmaceutical Association,* by shaking out the diethylphthalate from the sample with light petroleum ether, evaporating to dryness, adding sodium or potassium hydroxide, evaporating and adding a few drops of concentrated sulphuric acid and fusing with resorcin to an orange yellow color. By dissolving this fused mass in water and adding an excess of ammonia water a yellow-green fluorescence appears.

This test, however, is not satisfactory, especially if diethylphthalate is present in a minute amount. A blank test made by fusing resorcin with sodium or potassium hydroxide, taking up with water and adding an excess of ammonia water shows the same fluorescence.

A test which has been found very satisfactory can easily be performed. To 3 or 5 cc. of the sample in a test tube add 5 to 10

* Read before the 1922 Meeting of the Penna. Pharm. Assoc.

drops of phenol, 10 drops of concentrated sulphuric acid and heat slowly over a small bunsen flame until most of the alcohol has been driven off and the liquid assumes a red color. Now cool the test tube and cautiously add 15-25 cc. of water, when the red color will disappear and the liquid become turbid (if positive). Now add an excess of sodium or potassium hydroxide. A red color denotes the presence of diethylphthalate or a phthalein in the sample. Ammonium hydroxide is not recommended owing to the possible formation of phenol-di-iminophthalein, a substance giving a colorless solution with alkalies.

If the sample be alcohol or a colorless solution the test may be applied directly, but in testing whiskey better results are obtained by rapid distillation and the subsequent evaporation of the distillate to a small volume on a water bath. Good results may be obtained by shaking out with light petroleum ether a few times and then evaporating off the petroleum ether at a comparatively low temperature.

The test as described is rather delicate, considering that 1 cc. of a 1-1000 solution gave unmistakable results. The end reaction depends upon the formation of phenolphthalein by the action of hot sulphuric acid on phenol and diethylphthalate.

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PRINCIPLES OF PHARMACEUTICAL ETHICS.*

Chapter I.—The Duties of the Pharmacist in Connection With His Services to the Public.

Pharmacy has for its primary object the service which it can render to the public in safeguarding the handling, sale, compounding and dispensing of medicinal substances.

The practice of pharmacy demands knowledge, skill and integrity on the part of those engaged in it. Pharmacists are required to pass certain educational tests in order to qualify under the laws

* Presented by Dean Charles Herbert LaWall of the Philadelphia College of Pharmacy and Science before the Section on Education and Legislation of the American Pharmaceutical Association (Annual Convention, Cleveland, 1922). Revised, approved and referred by that Section to the General Session for approval and adoption. Adopted by the General Session and widespread publicity urged.

of our States. The States thus restrict the practice of pharmacy to those persons who by reason of special training and qualifications are able to qualify under regulatory requirements and grant to them privileges necessarily denied to others.

In return the States expect the Pharmacist to recognize his responsibility to the community and to fulfil his professional obligations honorably and with due regard for the physical and moral well-being of society.

The pharmacist should uphold the approved legal standards of the United States Pharmacopœia and the National Formulary for articles which are official in either of these works, and should, as far as possible, encourage the use of these official drugs and preparations and discourage the use of nostrums. He should sell and dispense only drugs of the best quality for medicinal use and for filling prescriptions.

He should neither buy, sell nor use substandard drugs for uses which are in any way connected with medicinal purposes.

The pharmacist should be properly remunerated by the public for his knowledge and skill when used in its behalf in compounding prescriptions, and his fee for such professional work should take into account the time consumed and the great responsibility involved as well as the cost of the ingredients.

The pharmacist should not sell or dispense powerful drugs and poisons indiscriminately to persons not properly qualified to administer or use them, and should use every proper precaution to safeguard the public from poisons and from all habit-forming medicines.

The pharmacist, being legally entrusted with the dispensing and sale of narcotic drugs and alcoholic liquors, should merit this responsibility by upholding and conforming to the laws and regulations governing the distribution of these substances.

The pharmacist should seek to enlist and merit the confidence of his patrons and when this confidence is won it should be jealously guarded and never abused by extortion or misrepresentation or in any other manner.

The pharmacist should consider the knowledge which he gains of their ailments, and the confidences of his patrons regarding these matters, as entrusted to his honor, and he should never divulge such facts unless compelled to do so by law.

The pharmacist should hold the health and safety of his patrons to be of first consideration; he should make no attempt to prescribe or

treat diseases or strive to sell drugs or remedies of any kind simply for the sake of profit.

He should keep his store clean, neat and sanitary in all its departments and should be well supplied with accurate measuring and weighing devices and other suitable apparatus for the proper performance of his professional duties.

It is considered inimical to public welfare for the pharmacist to have any clandestine arrangement with any physician in which fees are divided or in which secret prescriptions are concerned.

The pharmacist should primarily be a good citizen, and should uphold and defend the laws of the State and nation. He should inform himself concerning the laws, particularly those relating to food and drug adulteration and those pertaining to health and sanitation and should always be ready to co-operate with the proper authorities having charge of the enforcement of the laws.

The pharmacist should be willing to join any constructive effort to promote the public welfare and he should regulate his public and private conduct and deeds so as to entitle him to the respect and confidence of the community in which he practices.

Chapter II.—The Duties of the Pharmacist in His Relations to the Physician.

The pharmacist even when urgently requested so to do should always refuse to prescribe or attempt diagnoses. He should, under such circumstances, refer applicants for medical aid to a reputable legally qualified physician. In cases of extreme emergency as in accident or sudden illness on the street in which persons are brought to him pending the arrival of a physician such prompt action should be taken to prevent suffering as is dictated by humanitarian impulses and guided by scientific knowledge and common sense.

The pharmacist should not, under any circumstances, substitute one article for another, or one make of an article for another in a prescription, without the consent of the physician who wrote it. No change should be made in a physician's prescription except such as is essentially warranted by correct pharmaceutical procedure, nor any that will interfere with the obvious intent of the prescriber, as regards therapeutic action.

He should follow the physician's directions explicitly in the matter of refilling prescriptions, copying the formula upon the label or

giving a copy of the prescription to the patient. He should not add any extra directions or caution or poison labels without due regard for the wishes of the prescriber, providing the safety of the patient is not jeopardized.

Whenever there is doubt as to the interpretation of the physician's prescription or directions, he should invariably confer with the physician in order to avoid a possible mistake or an unpleasant situation.

He should never discuss the therapeutic effect of a physician's prescription with a patron nor disclose details of composition which the physician has withheld, suggesting to the patient that such details can be properly discussed with the prescriber only.

Where an obvious error or omission in a prescription is detected by the pharmacist, he should protect the interests of his patron and also the reputation of the physician by conferring confidentially upon the subject, using the utmost caution and delicacy in handling such an important matter.

Chapter III.—The Duties of Pharmacists to Each Other and to the Profession at Large.

The pharmacist should strive to perfect and enlarge his professional knowledge. He should contribute his share toward the scientific progress of his profession and encourage and participate in research, investigation and study.

He should associate himself with pharmaceutical organizations whose aims are compatible with this code of ethics and to whose membership he may be eligible. He should contribute his share of time and energy and expense to carrying on the work of these organizations and promoting their welfare. He should keep himself informed upon professional matters by reading current pharmaceutical and medical literature.

He should perform no act, nor should he be a party to any transaction which will bring discredit to himself or to his profession or in any way bring criticism upon it, nor should he unwarrantedly criticize a fellow pharmacist or do anything to diminish the trust reposed in the practitioners of pharmacy.

The pharmacist should expose any corrupt or dishonest conduct of any member of his profession which comes to his certain knowledge, through those accredited processes provided by the civil laws or

the rules and regulations of pharmaceutical organizations, and he should aid in driving the unworthy out of the calling.

He should not accept agencies for nostrums nor allow his name to be used in connection with advertisements or correspondence for furthering their sale.

He should courteously aid a fellow pharmacist who may request advice or professional information or who in an emergency, needs supplies.

He should not aid any person to evade legal requirements regarding character, time or practical experience by carelessly or improperly endorsing or improving statements relating thereto.

He should not imitate the labels of his competitors nor take any other unfair advantage of merited professional or commercial success. When a bottle or package of a medicine is brought to him to be refilled, he should remove all other labels and place his own thereon unless the patron requests otherwise.

He should not fill orders which come to him by mistake, being originally intended for a competitor.

He should deal fairly with manufacturers and wholesale druggists from whom he purchases his supplies; all goods received in error or excess and all undercharges should be as promptly reported as are shortages and overcharges.

He should earnestly strive to follow all proper trade regulations and rules, promptly meet all obligations and closey adhere to all contracts and agreements.

ABSTRACTED AND REPRINTED ARTICLES

THE HUMAN SIDE OF CHEMISTRY.*

By Edwin E. Slosson.

A hundred years ago chemistry was a toy. Today it is a tool. From the diversion of the philosopher it has developed into a practical profession of the highest importance to humanity. All the sciences may be expected likewise to earn their own living when they get old enough. But chemistry has in an astonishingly short time

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reached maturity and become more than self-supporting. We have recently seen factories hatching from test tubes, like fowl from eggs. Some of our friends in sciences that are older but do not yet pay dividends look upon chemistry with a certain suspicion and perhaps envy because of its success in a business way. They want to keep science as a sport and seem anxious lest the chemist lose his amateur status by making money. They need not worry, for whatever rewards come to the chemist—or to his employer—will be an infinitesimal fraction of what chemistry has given to the world.

The Chemist Too Modest.

The chemist is the most modest of men. He does not claim credit for what others do. He does not claim credit for all he does. Indeed, he often disclaims credit for some of his highest achievements. If he makes butter, he is willing that the credit should go to the cow, while he takes the cash; if he spins the silk for a dress he pretends that he is a mere worm; if he constructs a pearl he disguises himself as an oyster. He will even condescend to take the place of the humble tortoise and secrete a shell.

Modesty is an admirable thing, but it has its dangers if overdone. When you assume a deprecatory attitude toward your achievements, there is always the danger that other folks may believe you. They may take up at your own price mark. It is safe to profess unworthiness only when you are sure that those present will contradict you.

The result of this persistent attempt of the chemist to minimize his own importance is that the outside world fails to appreciate the value of his contributions to modern civilization and does not at all realize what the chemist might do in the future if he had a free hand. Don't camouflage your creations by calling them imitations. If you invent a synthetic plastic, some condensation product of phenol with an aldehyde or an amine, don't call it a mineral or vegetable. Name it after yourself.

A synthetic product should have a synthetic name. One of the fortunate effects of the unfortunate failure of our patent laws to afford proper protection is that it has led to the coining of new names for new things; too often to the coining of new names for old things, it is true, but still a good movement, for it brings people to the recognition of the fact that there are new things under the sun and

that most of them come from the chemist. The chemist has become the greatest coiner of words in the world. The rapid expansion of organic chemistry demanded the fabrication of some 250,000 new names, with provision for an indefinite increase in the future. Nobody ever had such a job since Adam was called upon to give names to all the animals as they filed before him. It meant doubling the dictionary. In accomplishing the gigantic task of constructive philology, the chemist has got some unwieldy combinations, but on the other hand he has, under the pressure of commercialism, contrived some very neat and handy nicknames for everyday use. The coinage of "Kodak" confounds the philologists. But they have determined the derivation of "balopticon" to their own satisfaction. It is derived, they say, from two Greek roots, "ballo," to throw, and "optikos," sight, a very proper term for a projection lantern, and removes the suspicion that the name of the apparatus might conceal a sly reference to its makers, the Bausch & Lomb Optical Company.

This is much better than the old custom of carrying over old names to new things. Fish glue films were called isinglass as though they were a kind of glass. When mica took its place it too was called isinglass, even in stove windows, and what is now called mica is mostly celluloid, and what is called celluloid, may be something else. Language lingers and lags behind the advance of science. That is because the public cannot realize the creative power of chemistry—that a compound is a different thing from the elements that compose it.

New Era in Chemistry.

In chemistry the whole is not equal to the sum of its parts, never qualitatively and possibly not always quantitatively. If we put together four atoms of hydrogen each weighing 1.008 we get one atom of helium that weighs only 4. The .008's have somehow got lost in the shuffle.

Chemistry is the creative science. Don't suspect me of taking advantage of my position to work in anything personal. I am quoting Berthelot, who foretold the time when all our foods would be made by the chemist. I do not see so far ahead as that, but it is certain that chemistry is entering upon a new era when its constructive powers will have wider scope and largely relieve us of our forms of life. The chemist of the future will not be content to do analytical

work such as the house wrecker does, or imitative work such as the forger does, but the chemist will do original work such as he alone can do.

The future of civilization is fixed by the scientist because he has the power to control the basic reaction on which our vital and mechanical power depends, the oxidation of carbon and hydrogen. All wealth is in its essence energy, and the material sources of energy are practically but two, food and fuel, very similar in composition and just alike in their final products. If the fuel falls short, our modern civilization will disappear and humanity will revert to a primitive condition. If our food supply falls short, life itself will be limited. The two factors of civilization, mass and potential, population and the standard of living, quantity and quality, are functions of the food and fuel supply. The Law of Malthus has often been refuted, but has never been repealed. The world has now been all surveyed and staked out in claims like a mining camp after the first rush is over. Quarrels over stakes and limits will continue and we can only hope that they will be settled in court rather than by the cruder methods of Roaring Camp. The late unpleasantness was started by a claim jumper who was too quick with his shooting iron and had to be handled by the vigilance committee. But how such quarrels are to be settled in the future is no more the concern of the chemist than of any other citizen. The peculiar business of the chemist is to see that there is something worth quarreling about. He is to show how to create and economize wealth and is not responsible for its abuse and destruction.

The period of the extension of civilization is approaching its end, and henceforth progress must take the form of intensification of civilization. People must cease to expand and begin to construct. There are no more continents to discover. No more worlds to conquer. The new era will require new methods and here the constructive powers of the chemist will come into play. The world will more and more come to depend upon him. It does not require any chemistry to pick a cocoanut off a palm tree. It only requires a rope and prehensile toes. But it does require chemistry to extract the oil from the copra and hydrogenate it and sell it as a bread spread to a hostile public. It does not require any chemistry to manure a field, but it does require chemistry to fix the free nitrogen of the air.

Chemistry is continually gaining ground from biology. Vast areas, which biologists once claimed but had neglected, have now gone over to the chemists. In fact, it seems that whenever a vital process or products had been thoroughly studied and understood, it is found to belong to physics or chemistry. Consequently, the chemist is inclined to regard biology as merely an unexplored province of chemistry. Many a loyal biologist in pursuit of some legitimate line of research well within his own territory has found in the course of time that he has unconsciously become a chemist. Pasteur many years ago crossed the boundary in the opposite direction; while hunting up assymmetric crystals he got over into abiogenesis. As an offset to our gains from biology we have lost to physics the invaluable province lying inside the atom. In the modus vivendi that prevailed when I was a student, anything bigger than the molecule belonged to the physicist, and everything smaller to the chemist. But a band of bold physicists, led by Thomson and Rutherford, made a raid into the hinterland of chemistry and captured the interior of the atom. Scientific boundaries, like national boundaries, are merely imaginary lines and may be drawn at convenience, though they are mostly drawn at inconvenience.

The new era that we are entering is a period of merger in the sciences. The traditional boundaries are being wiped out. The nice, precise, little, dogmatic definitions and distinctions that used to fill the first few pages of an elementary chemistry textbook have run together like bad dyes in warm water. The old arbitrary division lines between chemistry and physics, organic and inorganic, natural and artificial matter and energy, molecule and mass, chemical affinity and adhesive forces, are disappearing. Scientists are discovering what the artists have long known that there are no lines in nature.

Acetic acid may be made by a vinegar plant or by a hydro-electric plant. A reaction may be accelerated by a high temperature *or* a catalytic metal. It has recently been announced that rickets in children may be cured by sunlight *or* cod-liver oil. Let us hope that the children will be allowed their choice of which remedy they will take.

Every annual session of this society knocks some of our old ideas in the head. At this meeting Professor McKee will try to persuade us that there is no shale oil in oil shale, and Professor Bancroft that there is no color in the peacock's tail.

Chemistry is now passing through a revolutionary era like that of 150 years ago when Lavoisier's balance overthrew the phlogiston theory. But as Priestley stuck to phlogiston to the day of his death, although his discovery of oxygen had given it the deathblow, so some of us elders show a certain reluctance in relinquishing our old familiar images. There was something solid and satisfying about our molecular models made of wooden balls, stained with aniline dyes and stuck together with wires. But these have now been relegated to the top shelves of the storeroom and we have to get used to a newfangled atom, composed of a vacuum and algebraic symbols. Minus marks are flying round a plus mark like automobiles on a race course and whenever one skids it flashes its light. In place of a stout wirey valence bond, stiff and straight, that sticks when it is once put into its hole, we are offered two electrons playing tag in a ring, like cats chasing each other's tails.

But the new conceptions, as we all realize, are vastly in advance of the old, for they give us the ability to handle the ultimate and individual units of matter. Clerk Maxwell held that the laws of nature were merely and inevitably statistical, that we could only deal with averages of multitudes of indistinguishable molecules and movements. If that were true, chemistry would be less of an exact science than sociology, for the chemist cannot tell within many million how many molecules will pass in a minute through a tube connecting two flasks of gases of unequal density, while the social statistician can tell within a few thousand how many people will pass in a day through the Hudson tube connecting Jersey City and New York. But now that we have the power to discern and track the individual atom and even electron, Maxwell's argument no longer holds. We can sort out isotopes by their weights and divide electrons according to their velocities. We have, therefore, virtually found the sorting demon which, as Maxwell foresaw, might upset or evade the second Law of Thermodynamics and so bring order out of disorder and work out of uniform temperature.

Maxwell argues that all the atoms of an element must have the same weight, for he says ("Theory of Heat," p. 329):

"If the molecules of some substance, such as hydrogen, were of sensibly greater mass than others, we would have the means of producing a separation between molecules of different masses and in this way we should be able to produce two kinds of hydrogen, one of

which would be somewhat denser than the other. As this cannot be done, we must admit that the equality which we assert to exist between the molecules of hydrogen applies to each individual molecule and not merely to the average of groups of millions of molecules."

But now that Harkins has been able to separate hydrochloric acid gas into denser and rarer portions by simply passing it through a series of church-warden tobacco pipes, Maxwell's argument proves the reverse of what he thought.

Energy, like matter, has come under the atomic theory, and here, too, we are becoming acquainted with its individual units. As Millikan catches and counts the electrons on suspended droplets, so Silberstein catches and counts the quanta of light on Trivelli's silver bromide crystals. A single quantum of light knocks out an electron from a molecule and so disturbs the equilibrium of the salt that the whole crystal can be reduced to the metallic state by a developer. A faint light hits only a comparatively few crystals here and there upon the sensitive plate. A longer exposure hits some more. So Silberstein concludes that light comes like scattered raindrops, not in a continuous stream. I gather from this that we should not speak of "a flood of light," for according to Silberstein it never pours but it rains.

Possibly these wavy arrows of actinic rays, which knock off electrons so easily when they hit a metallic target, may instigate in the same way other or all reactions started by light. This may be the signal that starts the machinery going in the carbohydrate factory of the green leaf. If so, we may learn to better nature in this business as we have in others and set up solar engines of our own.

The chemist provides the motive power of the world, the world of man, not the inanimate globe. Archimedes said he could move the world if he had a long enough lever. The chemist moves the world with molecules. If he can only get control of the electron, he will be in command of unlimited energy. For in this universe of ours power seems to be in inverse ratio to size and the minutest things are mightiest.

When we enter the realm of intra-atomic chemistry, we get behind the elements and may effect more marvelous transformations than ever. The smaller the building blocks the greater the variety of buildings that can be constructed. The chemistry of the past was a

kind of cooking. The chemistry of the future will be more like astronomy; but it will be a new and more useful sort of astronomy such as an astronomer might employ if he had the power to rearrange the solar system by annexing a new planet from some other system or expediting the condensation of a nebula a thousand times.

But if the chemist is to become an electron astronomer, he will have to become a methematician of the highest order. He may even have to enter the fourth dimension. In the good old days a chemist did not have to know any mathematics but arithmetic and that only as far as percentage and the rule of three. He had nothing harder to do than to figure out his analyses so as to add up to 100 per cent., and he did not dare to bring them out exactly to 100 because that would look suspicious. But some twenty years ago it became apparent that the chemist could not keep up with the progress of his science unless he passed in mathematics beyond the eighth grade. It was then that I dropped out of chemistry and took to journalism, a field that so far has not been invaded by the mathematician.

The constructive chemist must often begin by destruction. He must shatter this sorry scheme of things in order to remold it nearer to his heart's desire. To effect the disintegration that must precede the reintegration, the most useful agencies are high temperature and pressure.

The Fuel Problem.

The strike has brought home to us the fuel question—since it does not bring home the fuel. The expansion of population and the development of civilization, even their maintenance at the present standard of life, depend upon finding new and perpetual sources of mechanical energy. The paramount importance of this question has been recognized by the International Research Council, which at its Brussels' meeting on July 25 adopted, as one of three subjects for co-operative study by the twenty nations represented, the investigation of the energy supply of the world. This was a project recommended by the National Research Council of the United States, which presented a plan for the systematic survey of all possible and conceivable means of obtaining mechanical power for the purpose of ascertaining which seem sufficiently adequate and feasible to warrant special research. In this international investigation of the dynamic foundations and future of our civilization, the American Chemical Society

is qualified to take a leading part. No achievements would be better worth our $25,000 prize than a discovery opening up a new source of mechanical energy.

All our food and all our fuel, all our muscular and machine power, depend upon the peculiar ability of the little green granules of vegetation to build up carbohydrates out of air and water. The green leaf reaction—or, if you insist upon having it in Greek, the chlorophyl reaction—is the sole support of all plant and vegetable life and without it the earth would be a desert planet like the moon.

If the work of the world were really done by "horse power," as we still call it, man would have reached the limits of civilization a hundred years ago, for a horse requires hay and hay requires land and there would not be enough land in the world to provide for the horse power we are now using. Supplementing the green fields with the coal fields, man has not only prevented civilization from coming to a stop, but has given it an unprecedented forward impetus. The iron horse feeds on subterranean pastures. He is living on crops of the Carboniferous Era. Modern civilization basks in the sunshine that fell upon the earth unmeasured millenia ago. We are living on our capital, drawing on the coal banks. Sometime we must begin to earn our own living, to grow our fuel as we go.

Meantime, the amount of solar energy that is being stored up in the plants every summer is ten times as great as that released by the combustion of coal. But coal is more condensed and convenient than wood. Oil and gas are still better fuels. It would seriously check the progress of civilization if the world had to return to the wood basis as it was 150 years ago.

We have been wasting year by year half of our natural gas and three-quarters of our petroleum. The supply of gas has fallen off by a quarter in the last five years, and soon will be running short. Our oil reserves will not last long, fifteen or twenty years at the present rate of consumption is all the geologists will allow us. At any rate the gasoline tank is getting low and no service station is in sight.

Still the trees and tiny plants flaunt their foliage provocatively in the face of the passing scientist, who must confess that he cannot yet accomplish what they do so easily—these little green-leaf laboratories, these filmy factories, noiseless, smokeless, odorless, that with no reagents but air and water and no power but the sunshine build

up by the ton the most complicated carbohydrates out of the simplest compounds of the commonest elements, carbon, hydrogen and oxygen.

Still, the sun, sole source of all our life and weather, floods half the earth with its rays, and the land that receives the most of this potential wealth is the land that retains the least of it, the arid region of the tropics. A section of the Sahara, forty miles square, receives in six hours a day as much heat as is produced by the coal burned in the twenty-four hours throughout the world. If only a small fraction of this wasted energy could be economically stored up and set at work by some sort of solar engine, we need not worry about the exhaustion of our oil, gas and coal. There would be wealth enough for all.

Here, then, is the greatest problem of conservation, the kind of conservation that consists in utilization. But, being accustomed to such wasefulness, it does not excite attention. Nobody is bothering about it except a few chemists, and they do not know how to help it.

Every tiny grass blade points the finger of scorn at the chemist and says "Se how we do it. Don't you wish you could?"

And the chemist, with command of pressures varying from a vacuum to the point where steel flows like tar, and with command of temperatures ranging from the boiling point of carbon almost to absolute zero, is still obliged to confess that he cannot accomplish on a commercial scale the simple reaction of the polymerizing of formaldehyde. Even if he knew how, he could not hope to compete with plants on their own ground because they have at their command free raw materials and the cheap labor of protoplasm. Even a professor of chemistry cannot live as cheaply as a cornstalk.

But there are as many celluloses as there are sugars and it is not probable that those that the plants have prepared for their own purposes would be the best for all human purposes. Just as we have found that better dyes and drugs can be made in the factory than can be found in nature, so we may surmise that some of the fundamental foodstuffs—starches, sugars, fats and even proteins—may possibly be improved upon.

More important and promising than the possibility of synthetic food is the possibility that we may devise some better method of capturing solar energy than the plants have hit upon. We have no reason to assume that the carbohydrates are the only way of solidify-

ing sunshine. The chlorophyl process is shockingly wasteful. Less than one per cent. of the solar energy that falls upon a leaf is fixed in the form of carbohydrates, from which it may be later released by oxidation. The crude steam engines, set up in Egypt, catching sunshine by cylindrical mirrors and throwing the heat upon blackened water pipes, have an efficiency of some four per cent., much higher than the green plant.

But a steam engine at best is an inefficient machine, and now that we are able to guide streams of electrons where we will and sort them out according to speeds by means of grids acting like Maxwell's demon, we may reasonably hope to utilize the radiant energy of the sun directly for power purposes. This is not a visionary project such as drawing upon the exhaustless forces inside the atom. That may, for all we know, remain forever an impossibility. What I am talking about, the fixation of solar energy, is something that we know can be done, for we see it in the grass every sunny day. If sunshine can excite a selenium cell and decompose silver bromide on a photographic plate, it may be made to do work of another sort and on a larger scale. Here, at any rate, is the greatest problem that the world presents, and the highest prizes are offered for its successful solution.

"Experiments of Light."

I suppose that all of us have tried erratic experiments that we would not care to confess before our colleagues in such an assemblage as this. Crazy ideas will pop up in the best-regulated brains from some subconscious cellar, and we try them out on Saturday afternoon when there is nobody else around, just to see what will come of them. They do not appear in our published reports—unless they happen to succeed—in which case we claim full credit for our foresight in undertaking an operation that ordinary minds would have condemned in advance as absurd.

Now it is interesting to observe that such irrational experimentation is distinctly recommended by the philosopher who laid down the laws of experimental science that have in the three centuries since accomplished such amazing achievements. Lord Bacon, after listing in his precise and orderly manner all the various ways that we may be guided in our researches by theory, observation and previous experiment, concludes quite unexpectedly by adding a new category, what he calls the experiments of a madman, and defines as follows:

"When you have a mind to try something not because reason or some other experiment leads you to it, but simply because such a thing has never been attempted before. The leaving I say of no stone in nature unturned. For the magnalia of nature generally lie out of the common roads and beaten paths so that the very absurdity of the thing may sometimes prove of service. But if reason go along with it, that is, if it be evident that an experiment of this nature has never been tried, then it is one of the best ways and plainly shakes the folds out of nature."

The example Bacon gives of such unprecedented experiments is of peculiar interest to us:

"But of what I may call close distillation no man has yet made trial. Yet it seems probable that the force of heat, if it can perform its exploits of alteration within the enclosure of the body, where there is neither loss of the body nor yet means of escape, will succeed at last in handcuffing this Proteus of matter and driving it to many transformations; only the heat must be so regulated and varied that there be no fracture of the vessels.

"No one should be disheartened or confounded if the experiments which he tries do not answer his expectation. For though a successful experiment be more agreeable, yet an unsuccessful one is oftentimes no less instructive. And it must ever be kept in mind (as I am continually urging) that experiments of Light are even more to be sought after than experiments of Fruit."

What Bacon was "continually urging"—that "experiments of Light," those that lead to enlightenment on fundamental principles, "are even more to be sought after than experiments of Fruit," those that bring practical results—needs more than ever to be kept in mind at the present day, when public and employers are impatient of research that does not bring immediate and profitable returns. So it is worthy of notice that the example which Bacon cites as the experiment of a madman—that is, destructive distillation—has been peculiarly productive of both Light and Fruit. Applied to coal, it has given us coke for metallurgy, gas for cities and shops, and coal-tar products of innumerable variety and inestimable value. Applied to petroleum, it has increased the yield of gasoline by some 2,000,000 gallons a day. By thus "handcuffing this Proteus of matter and driving it to many transformations" we have gained an insight into the structure of the molecule and the chemistry of life.

An Agent for Democracy.

Chemistry is the most effectual agent for democracy, since it actually accomplishes in regard to many material things that equality which legislation aims to bring about in the political sphere. Luxuries, formerly the monopoly of the privileged classes, become, through applied science, the common property of the masses. The "royal purple" of the ancients and dyes far more beautiful are now to be had on the bargain counter, and Solomon in all his glory was not arrayed like the modern American maiden. Even though her purse be scant she need not lack jewels and perfumes and fine raiment such as once were worth a slave's life. In early ages the man who owned a piece of steel shaped it into a sword and made himself master of his fellows. Now we make buildings out of steel and he who lives in the garret of one of them could look down on the tower of Babel. The Feudal Age vanished at the first whiff of gunpowder, for that device of the Black Art leveled the natural and the artificial inequalities of humanity in warfare, for with a gun in his hand the churl could meet the knight on equal footing and the dwarf was match for the giant—more than a match, for he had the larger target. Medicines such as a prince could not have procured, though his physicians surveyed the earth from China to Peru, are now at hand to cure the pauper. The new chemical motive powers have given man in the automobile a very fair substitute for the seven-league boots of the fairy tale; they enable him to go down into the sea in ships on more or less lawful occasions, and they have endowed him with the wings that he has always longed for but never expected to get until he reached Heaven. Books are no longer chained up in treasuries, but, manifolded by the magic of ink, are to be bought on the street corner like peanuts; pictures from the private gallery of prince or plutocrat are multiplied by the same mechanism and scattered throughout the land. We do not have to pay ten dollars to hear one song by Galli-Curci since we can hear her at home with as many encores as we like. Caruso, though dead, yet speaketh. His voice has been embalmed by carbolic acid. Events that few could witness are brought to all of us on the celluloid film. So, whether it be the satisfaction of our material wants or the gratification of our aspiration for art and literature, the chemist acts as the agent of applied democracy. Democracy has been engaged in a struggle for life lasting five years and has

emerged triumphant—thanks to the chemist. For war has now become essentially a branch of applied chemistry, carried on almost entirely by chemical weapons and chemical defenses. Germany, regarding herself as the heaven-born leader of mankind in this science, attempted to use it to establish her political supremacy in the world, but in spite of her advantage at the start she was foiled in the end by the democratic nations. She had freed herself in advance from dependence upon the nitrate beds of Chile for her explosives by developing methods of making nitrates from the air.

The war is over and Germany has been relieved by the Allies of the burden of armament that still weighs upon the victorious nations. But Germany, unlike the United States, finds it profitable to proceed with the Haber process even in time of peace. We need have no fear of such a catastrophe as the explosion of Oppau. If the Muscle Shoals plant should blow up now, the loss of life would be considerably less. It is curious to recall that the allied aviators were never able to blow up the Oppau works despite their gallant and persistent attempts, yet now the Germans without ouside aid have removed the entire establishment from the earth with the greatest ease. The moral of this is the old maxim, "If a thing is to be done, do it yourself."

The Washington Conference on Reduction of Armament decided to prohibit the toxic forms of chemical warfare, but not the explosive. Consequently, we cannot use gases against our foreign foes, though they may be still employed against our own people when disorderly. Even the comparatively mild lachrymatory and sternutatory gases are officially debarred. We may use chemicals to draw blood from our enemies but not to draw tears. Our military authorities seem determined that the American Army shall never be sneezed at.

Whether this paper prohibition will hold against an unscrupulous or desperate enemy or whether our soldiers may some day be caught unprepared as were the British at Ypres, must be left for time to determine. But since the chemists of the country are not responsible for the risk, they may rejoice in the meantime at being relieved of the distasteful task of devising modes of destruction and concentrate their attention upon the constructive side of their science.

Sociological Influence.

The chemist is not merely a manipulator of molecules; he is a manager of mankind. His discoveries and inventions, his economies and creations, often transform the conditions of ordinary life, alter the relations of national power, and shift the currents of thought, but these revolutions are effected so quietly that the chemist does not get recognition for what he accomplishes, and indeed does not usually realize the extent of his sociological influence.

For instance, a great change that has come over the world in recent years and has made conditions so unlike those existing in any previous period that historical precedents have no application to the present problems, is the rapid intercommunication of intelligence. Anything that anybody wants to say can be communicated to anybody who wants to hear it anywhere in all the wide world within a few minutes, or a few days, or at most a few months. In the agencies by which this is accomplished, rapid transit by ship, train or automobile, printing, photography, telegraph and telephone, wired or wireless, chemistry plays an essential part, although it is so unpretentious a part that it rarely receives recognition. For instance, the expansion of literature and the spread of enlightenment which put an end to the Dark Ages is ascribed to the invention of movable type by Gutenberg, or somebody else, at the end of the fourteenth century. But the credit belongs rather to the unknown chemist who invented the process of making paper. The ancient Romans stamped their bricks and lead pipes with type, but printing had to wait more than a thousand years for a supply of paper. Movable type is not the essential feature of printing, for most of the printing done nowadays is *not* from movable type, but from solid lines or pages. We could, if necessary, do away with type and press altogether, and use some photographic method of composition and reproduction, but we could not do without paper. The invention of wood-pulp paper has done more for the expansion of literature than did the invention of rag paper six hundred years ago.

For the conveyance of ideas the picture is often more effective than the word and here the photographic processes of multiplication due to the chemist are the essential factors.

It is interesting to live at a time when we can witness the birth of a new art. Such was the last quarter of the fifteenth century when the art of printing books was being developed. Such is the first quarter of the twentieth century when the art of depicting motion is being developed. In fact, the moving picture has a better title to the term "a new art" than had printing, to which it was applied so long ago. Printing was not so much a new art as a mechanical extension of an old art, one of the oldest and best developed of the fine arts, the art of calligraphy. The first printed books were but cheap and inferior imitations of the handsome handwritten volumes of that day. Even today with four hundred and fifty years of progress it is in cheapness and convenience rather than beauty that the modern book surpasses the ancient manuscript.

Now in the same way the moving picture does for the drama what printing did for literature, that is—it brings it within reach of the multitude through a process of mechanical manifolding. But it does something vastly more important than this. It makes possible for the first time the unlimited reproduction of actual events. This world of ours is a moving world and no static art can adequately represent it. There is no such thing as still life, or still anything else in the whole universe. Everywhere and always there is motion and only motion and any representation of reality at rest is a barefaced humbug. The more realistic the painting or sculpture the more obvious the failure. Myron's "Discobolus" and Meissonier's "Friedland" are as unnatural and fictitious as a centaur or a hippogriff. The most beautiful painting ever put on canvas, the finest statue ever carved, is a ridculous caricature of real life compared with the flickering shadow of a tattered film in a backwoods nickelodeon. We have now for the first time the possibility of representing, however crudely, the essence of reality—that, is motion. Bergson has shown us what a paralyzing influence static conceptions of reality have had upon the history of philosophy and how futile have been all attempts to represent movement by rest. The scientist of today thinks in terms of motion. All modern thought is assuming kinetic forms and we are coming to see the absurdity of the old ideas of immutability and immobility. A similar revolution is impending in art. At least we glimpse the possibility of a new form of pictorial art, which, if capable of development as it seems to be, will make our present pictures appear as grotesque as the reliefs carved on Egyptian tombs or the

scrawls on the caverns of Altamira. What will our posterity, familiar with moving portraiture, think of our admiration of Mona Lisa's smile, frozen on her lips for four centuries? A smile is essentially a fleeting thing, an evanescent expression. A fixed smile is not a smile at all but a grimace. It is only by the most violent effort of the imagination that we can ignore the inherent artificiality and limitations of painting sufficiently to get from it the illusion of reality.

Metaphysics of Chemistry.

In considering the contributions that chemistry has made to our wealth and comfort, we must not forget that every fundamental discovery alters also our attitude toward life and consequently our conduct. There is a metaphysical as well as a physical side to chemistry. The new conceptions of the atom and of the sidereal universe, of matter and energy, of time and space, developed within the last ten years, will inevitably transform the prevailing modes of thought in philosophy, religion, and sociology as much as did the Copernican idea of the moving earth in the fifteenth century and the Darwinian idea of developing species in the nineteenth century.

The theory that the heat of the stars comes not from gravitational contraction but from such intra-atomic sources as the formation of helium from hydrogen has extended the life of our sun by some thousands of millions of years, and thereby the limitation of life on the earth and the possibility of the development of a superior civilization. So we don't have to hurry so hard as we did when we thought that the sun was a guttering candle, likely soon to flicker out and leave us in the dark and cold. We used to watch with anxiety the periodical reports of Langley and Abbott as to the constancy of the solar constant in order to see how much more time we had to perfect our social system before night, for when we looked at the daily papers we did not seem to be making progress very rapidly and it looked as though we should all be Eskimos before we got our society to suit us.

The mind is supposed to be immaterial but it seems to be possessed of inertia. The more quickly you want to move the mind of man the greater the power that it is necessary to apply. To move the mental mass of the nation greatly requires almost infinite expenditure of energy or almost infinite time. Since scientific men devote

very little energy to the propagation of their views, it takes a very long time for new scientific ideas to act upon the popular mind. There is consequently a lag in the progress of civilization, a break in the line of march between the vanguard and the rank and file.

This is largely due to the lack of efficient terminal facilities in the delivery of intelligence. Transportation experts tell us that often a larger part of freight charges is consumed in the short haul between station and home than in the long haul by ship or train. So it is in the transmission of ideas. An idea may be sent around the world at the rate of 186,000 miles a second, but the short haul between the eye or ear and the brain may require twenty years. If the message is in a foreign language, such as scientific terminology, and there is no translator about, the reception of the intelligence by the average mind may be indefinitely delayed.

Need for Popularization.

Chemistry has long since abandoned the pretension of being a secret science, but it has not yet become a public science. It has the air of being much harder to understand than it really is. Its symbols are almost as repellant to unfamiliar eyes as are the mathematical signs of physics. The verbal formulas, by which compounds are designated, are mistaken for names and considered unpronounceable. But such impediments to popularity are not peculiar to chemistry. Other sciences, quite as much handicapped by strange nomenclature and recondite conceptions, are nevertheless read with eagerness by the public. Astronomy, which is largely mathematical and has no practical value for the reader and does not deal with human beings or any living thing, is still one of the most popular of the sciences. We have to put an astronomical article into our *Science News Bulletin* every week to satisfy the newspapers to which it is syndicated, but if we omit a chemical article we get no complaints.

One reason why the public is not so much interested in chemical research as it ought to be is the lack of writers willing to translate the science into ordinary English and present it in an attractive style. I speak with some assurance on this point for it has been my business, ever since Science Service was founded a year and a half ago, to hunt for people trained in the several sciences who can and will write about them for newspapers and magazines,

and I have found it more difficult to get good writers in chemistry than any of the other sciences. Yet there are more chemists in the country than any other scientists. Not all of them are so absorbed in research, teaching, or industry, that they could not find a leisure hour for writing once in a while. I can find plenty of people to write about birds or bugs, clouds or stones, crinoids or endocrines, stars or starfish, but I find few who will tell the thrilling continued story of chemical discovery.

Yet no science touches human life more intimately than chemistry. None is of more practical importance in industry. None is turning out more sensational novelties. None has a more varied and romantic history.

Of its technical literature chemistry may well be proud. The three journals of this Society, and especially our system of abstracts, are the envy of all the other sciences, and there are various other able and attractive journals of chemical science and industry. But these are read exclusively by chemists and there is no popular periodical of chemistry published anywhere in the world. In the popular science periodicals and in the scientific articles of the general magazines, chemistry does not fill as large a space as its practical importance and intrinsic interest demands. At least so it seems to a chemist. The chemical news service of this Society is doing a splendid work in preading chemical information through the newspapers, and the Local Sections are bringing our science to the attention of the public by their meetings, but there is need for other kinds of chemical literature, especially for magazines and books. Last year the Washington Academy of Sciences prepared, at the request of the Washington Public Library, a list of One Hundred Popular Books in Science. In many fields, such as botany, astronomy, paleontology, entomology, and the like, there was an embarrassment of books to choose from, but when it came to the science of chemistry Dr. Sosman, chairman of the committee, reported that not one could be found. There were several popular books on special topics, such as the chemistry of commerce, industry and everyman's life, but none that treated the science as a whole and satisfied the requirements of the selection, which were that the book should be readable by the ordinary reader, not a textbook, not a reference book, not a home study course, but so written that it would interest one who had no previous knowledge of the

subject and no special reason for wanting to know about it. It is worthy of note that the committee had to go abroad for some forty per cent. of its popular science books, and that several of them were over fifty years old, although a recent book would be preferred. Yet some of these British books find their greatest sale in the United States, notwithstanding the advantage that an American writer has in local references and colloquial language. It would seem that a hundred million readers might reasonably expect to have one popular book in each science once in fifty years in order to keep within sight of scientific progress.

I would not take up so much of your time with my business, but it is your business, too—at least I hope to persuade you that it is. I am glad to see that you have already taken a step that will aid in the popularization of the science by organizing a Section of History of Chemistry. For one of the reasons why science is caviar to the general public, is that it has been so conscientiously depersonalized. The effort is constantly made to reduce science to a set of mathematic formulas, free from all taint of time, place, and personality, bearing no trace of its erratic history and early gropings in the dark. This is quite a proper procedure for the development of the science, no doubt, but it has the unfortunate effect that in eliminating the human element you have eliminated the human interest. C. P. sucrose is a beautiful product, a triumph of technology in which the Division of Sugar Chemistry may well take pride, but it is not so tasty as maple sap or cane juice. It has lost its vitamins. That, I think, is why pure science is distasteful to the layman. It has lost its vitamins. To put a modern, high-grade textbook in the hands of the ordinary reader is like feeding decorticated rice to a soldier. It gives him mental beriberi. I hope I will not be misunderstood as saying anything against the chemist's constant efforts to achieve a higher degree of purification. Perfect purity is a noble aim even though it be asymptotically unattainable to human beings. There was once a little girl who prayed: "O God, make me pure; make me absolutely pure like Royal Baking Powder!" Now it does not do any harm for baking powder to be pure because it gets mixed with so many other things, but if the flour is absolutely pure, and the fat, and the salt, and the water, well, somehow the bread is not so nutritious as it might be.

I am not sure than even in a textbook a bit of history or a few personalities would be out of place, though they might give the student the idea that the principles of the science have been worked out by slow degrees and much blundering by fallible human beings instead of being handed down in perfect form on tables of stone like the Ten Commandments. But anyhow, I am sure that for the general reader it is best not to refine too highly but to leave in a little of the human alloy. And I hope that your Section of History will develop some young writers who will turn out a readable character sketch of the creators of chemistry, or a dramatic description of how their discoveries were made and what they mean to the world. One can get such "human interest stories" in abundance about authors, artists, musicians, statesmen and warriors, but I have been searching in vain for writers who would do as much for science. Until such writers are found we cannot expect readers in general to take as much interest in science as they do in literature, fine arts, politics, and war.

POND LIFE.*

By John Rae, M. P. S.

Many pharmacists and students are no doubt owners of microscopes, but are probably unaware of the infinite variety of objects to be found in pond water. An ordinary student's microscope is all that is necessary for the work, unless one wishes to see such things as the fine markings on diatoms, for which a high power is necessary. When collecting the water collect a little of the mud, and also plenty of pond weed, which will keep the water sweet. On returning home empty the water into a large glass jar—jam jars do very well; the mud will soon sink to the bottom, leaving the water quite clear, with the weed floating on top. If the water is now examined in a good light, quite a number of minute animals are to be seen with the naked eye, such as the cyclops and water-flea. By means of a dipping-tube transfer some of the water to a small watch-glass; from this the objects are easily lifted with a fine brush to a slide which is slightly hollowed out in the centre, or to a live box.

* Reprinted from *Pharm. Journ. and Pharm.*

Cyclops and Other Species.

Under even a very low power the cyclops, one of the *Copepoda*, so called from the one big eye in the centre of its head, looks quite terrifying, having the appearance of being encased in a coat of armor. The female is easily distinguished by the presence of two large egg sacs, one on each side.

The water-flea, *Daphnia Pulex*, is perhaps more interesting than the cyclops, owing to the fact that it is quite transparent, and gives one the impression of watching the movements of a very complicated watch.

Amongst the comparatively large objects are curious-looking larvæ of certain insects such as the dragon-fly and others of the mosquito type, which during their wonderful metamorphosis from egg to perfect insect spend part of their life as humble pond dwellers. The tail, by means of which they dart about with great rapidity, is well worth examining, also the head, which in some species is somewhat like a monk's cowl.

If a drop of what would appear to be perfectly clear water is taken from the specimen jar and placed under a moderate power, the water appears to be full of minute, almost transparent objects, which seem to be constantly moving along at what for their size must be a great rate. These animalcula are easily found in water in which dry hay has been soaked for a few days. They are very low in the scale of evolution, and were made use of by the exponents of the doctrine of spontaneous generation.

Vorticella.

One of the most beautiful objects to be found in pond water is a colony of bell animacula, or *Vorticella*. If the stem of a piece of water weed is placed under the microscope and left undisturbed for a few minutes, the field will probably be found to contain some transparent, cup-shaped objects, which are attached by means of long stalks to the stem of the weed. Cilia, which move at a great rate, cause a current of water to be constantly passing the mouth. This current of water, containing a supply of food material, is easily noticed by means of particles which are floating in it. The sea anemone, familiar to all lovers of natural history at the seaside, obtains its food

in a somewhat similar manner. *Vorticella* are extremely sensitive, and the slightest movement of the microscope is sufficient to cause the thin stalk to contract, when they become almost invisible. This explains why it is necessary to wait for a short time after transferring them to the slide before they gain sufficient courage to appear.

Rotifera,

or wheel animalcula, are to be found in abundance in pond water, and also in rain-water cisterns. Some of them attach themselves to pieces of wood or pond weed. Rapidly-moving cilia give one the impression that the head is constantly revolving. They are extremely hardy, and during drought are able to live encased in dry mud for long periods.

Volvox Globator,

a fresh-water unicellular plant, which attains a diameter of about one-twentieth of an inch, has the appearance of a ball covered with a fine network. The next generation is visible as free swimming plants in the cavity of the parent, where they remain until it dies and the outer wall is ruptured.

Other Objects.

Other objects to be looked for include *Ulothrix Zonata,* a fresh-water plant, which one may be lucky enough to see in a state of conjugation. Also *Pandorina Morum,* and *Nostoc,* a curious long green filament composed of a chain of cells, the regular character of which is broken at intervals by the presence of a large inert cell called a heterocyst. An allied object is *Oscillaria,* which, as its name implies, is constantly oscillating like the pendulum of a clock. When watching it one is almost hypnotized by its regular steady movement.

So far only the extreme edge of one of the most interesting pastimes has been touched, but when once commenced the study of pond life becomes so engrossing that when a colony of *Vorticella* are under observation one quickly becomes oblivious of time, hunger, and fatigue.

AN INVESTIGATION OF THE ALKALOID COLCHICINE: ITS ASSAY, ISOLATION AND SPECIAL PROPERTIES.*

By E. C. Davies, M. Sc., M. P. S., and James Grier, M. Sc., Ph. C.

At last year's meeting, at Scarborough, of the British Pharmaceutical Conference, a paper on "The Assay of Colchicum by the Phospho-Tungstic Method" was contributed by E. C. Davies (*vide* Year-Book, 1921). The present contribution is a further development of the subject, and deals with the isolation in quantity of colchicine and with its assay by volumetric and gravimetric methods with Mayer's and Schiebler's reagents, and also by colorimetric methods, and finally with the special properties and reactions of the alkaloid. In the *isolation of colchicine* in quantity from the seeds and corms satisfactory precipitation of the alkaloid by phospho-tungstic acid was found to be possible only in presence of sodium chloride along with acid, and as the result of experiments systematically carried out it was found that 0.5 per cent. HCl plus 2 per cent. NaCl gave the best results, and represents the ideal conditions for such precipitation. The much weaker acid required also lessens the risk of alteration of colchicine. The seeds and corms were first exhausted with industrial methylated spirit in a special Soxhlet apparatus with the boiling flask placed at the side, not underneath, so as to avoid exposure of the powdered drug to heat, and also to obtain thorough exhaustion with the minimum amount of solvent. 150 gms. of powdered drug were thoroughly exhausted with 350 cc. of solvent during three days or less, the alcohol was recovered, the residue extracted with hot water, any oil present shaken out with ligroin, and the impure alkaloid shaken out with chloroform. The dark colored chloroform residue was again extracted with hot water, and the filtered yellowish-green liquid precipitated with phospho-tungstic acid in presence of 2 per cent. NaCl and 0.5 per cent. HCl. The yellow granular precipitate was collected on filter paper and washed free from NaCl wth 0.1 per cent. HCl, then rinsed into a separator containing chloroform, ammonia added in slight excess, the chloroform washings evaporated and the residue taken up with q.s. 50 per cent. alcohol and dried on

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plates. The product was yellow with m.pt. 144° C., and very readily and entirely soluble in water, indicating its purity. A specimen of Merck's pure colchicine from the Materia Medica Museum of the Manchester University gave a m.pt. of 142° C. It was yellow in color, and when tested by the phospho-tungstic method indicated 97.6 per cent. purity. No difference was found in the colchicine from the seed and corm. A commercial specimen of so-called pure colchicine proved on examination to be an impure form of colchicine tannate with m.pt. 120° C. The phospho-tungstic method of isolating colchicine is a great improvement on the older method (see Remington) of precipitating with tannin and digesting the tannate with lead oxide, which method gives a dark brown resinous mass soluble in water only with difficulty. It was found that by decomposing the colchicine tannate in 10 per cent. alcoholic solution with lead nitrate solution, then the excess of lead with dilute sulphuric acid, and finally shaking out with chloroform, a light brown product, m.pt. 140° C., was obtained.

Zeisel's method, which consists in repeated solution of the alcoholic residue in water and shaking out with chloroform so as to obthen regenerating the alkaloid by heating with q.s. water at 50° C., tain the chloroform addition compound $C_{22}H_{25}NO_6 2CHCl_3$, and gave a light brown amorphous product with m.pt. 136° C.

The relative value of different *solvents* in the extraction of colchicine was investigated. Using the Soxhlet apparatus, it was found that chloroform, ethyl alcohol, methyl alcohol, and methylated spirit gave complete extraction in three to four hours, using 10 gms. of powdered seed and 100 cc. solvent. In six hours ether and benzene extracted 80 per cent. of the colchicine present, and carbon tetrachloride 72 per cent.; while in twelve hours amylic alcohol extracted only 53 per cent. In all these cases the colchicine was a dark brown resinous mass, indicating the advantage of purification by precipitation by the iodine or phosphotungstic method. Based on the above experiments a rapid but not absolute process of assay was devised where the alcoholic extract was extracted with hot benzene, and subsequent shaking out with N/10 acid and then with chloroform. It indicated 87 per cent. of the colchicine present.

Volumetric methods of assay with Mayer's reagent were carried out in 2 per cent. H_2SO_4 solution, using Merck's pure colchicine

for the purpose. The centrifuge was utilized to get rapid and complete separation of the precipitate, and so enabled the estimations to be carried out more rapidly and with greater delicacy as compared with the old slower method of gradual precipitation with filtration after each addition. 1 cc. of N/20 Mayer = 0.011 gm. colchicine (Merck), which corresponds closely with the empirical figure 0.0147 given in Lyons' "Assay of Drugs," page 143. Volumetric assay was also carried out with Schiebler's reagent in presence of 1½ per cent. H_2SO_4 with the aid of the centrifuge. The precipitate so obtained was also ignited, decomposing at 200° C. into $P_2O_52OWoO_3$. Precipitation with Schiebler's reagent was also done in presence of 2 per cent. NaCl and 0.5 per cent. HCl. In this case the precipitate was granular (that got with H_2SO_4 alone was not), and could be collected, washed and dried on a filter paper without the aid of the centrifuge. It was then ignited. The results of these volumetric and gravimetric estimations carried out with Schiebler's reagent established the ratio of 1 of colchicine to 3.3 of phosphotungstic acid as the proportions by weight in which they combine, and this agrees closely with the formula of four molecules of colchicine to one molecule of phosphotungstic acid. Heiduschka and Wolff (Year-Book, 1921) find the ratio to be 1:3 with less than 1 per cent. HCl, and indicate that for aconitine and nicotine this method is preferable to the silicotungstic method.

Method of estimation by *Nesslerising.* Both acid and alkali give yellow colors with colchicine, but that with alkali—particularly KOH—is more intense, indicating a dye-structure probably. In fact, colchicine may be used as an indicator. With weak, *i. e.,* N/10, acid no color is appreciable, but one drop in excess of N/10 alkali produces a greenish tint. The intensity of the color, faint green to dark olive green, using dilute solutions of colchicine, depends on the strength of the alkaloidal solution, 0.008 per cent. representing the limit of color production. The method is quite reliable within the limit stated, and may be used to estimate colchicine in dilute solutions *colorimetrically.* It is simpler and more easily applied than the $FeCl_3$ and HCl colorimetric method suggested by Fabinyi in 1912. The acid color is easily removed by chloroform, but is not affected by NH_4Cl; the alkali color, on the other hand, is difficult to remove by chloroform, but is immediately decolorized by NH_4Cl.

Properties and Reactions of the Alkaloid Colchicine.

Colchicine, $C_{22}H_{25}NO_6$, occurs in pale yellow flakes, or as a pale yellow amorphous powder, with a bitter taste, and giving off a haylike odor when damped and warmed. Dose, 1/20 to 1/30 grain; lethal dose, .0012 gm. per kilo body weight. M. pt. U. S. P. viii, and B. P. C. gave 142.5° C., but 145° C. that of the French Codex, was recommended for U. S. P. ix, which has adopted 142° to 146° C., and this range includes the melting points 142° C. and 144° C. obtained in this investigation. Merck (Year-Book, 116) says pure colchicine forms white amorphous flakes, m.pt. 142-147° C., which, from its aqueous solution, deposits large yellow crystals of the sparingly soluble hydrate $(C_{22}H_{25}NO_6)_2.3H_2O$. Fuller gives 120° C. for the crystalline form, and 140-145° C. for the resinous (amorphous) form. As the yellow color, on exposure to light and air, becomes dark brown, colchicine and its "salts" should be stored in well-stoppered amber bottles in a dark place. It is soluble in water 1 in 22, the solution being neutral to litmus and lævorotatory, less soluble in warm water 1 in 26 at 80° C., very soluble in chloroform, methyl alcohol, methylated spirit, and in 90 per cent. ethylic alcohol, but less so in absolute alcohol. It is not very soluble in benzene 1 in 87, or in ether 1 in 155, still less in carbon tetrachloride and amyl alcohol, and insoluble in petroleum benzin. It is soluble in glacial acetic acid to form a colorless liquid which dries to a colorless transparent varnish; in fact, acetic acid is a good solvent. In acetic solution it exists as the single molecule, but in aqueous solution it occurs as the double, or even the triple, molecule (Zeisel and Stockert). Colchicine forms addition compounds with chloroform, bromoform, and ether, which compounds are decomposed at 100° C., or, when warmed with water, at 50° C., in the latter case with formation of the hydrate. Chloroform extracts it completely from acid solutions, distinction from berberine, one of the few other yellow alkaloids. With alkalies it forms yellow resinous compounds, which are difficult to resolve with chloroform; in fact, it is essential to have the chloroform present before shaking out with alkali. Warmed with dilute acids or alkalies, it yields methyl alcohol and colchiceine. On account of the ease with which colchicine is hydrolyzed, it is probable that colchiceine is present to a greater or less extent in most of the colchicine residues obtained in analytical work (Fuller, "Assay of Drugs").

Colchiceine, $C_{21}H_{23}NO_6.\frac{1}{2}H_2O$, occurs in shining white needles. M. pt. 172° C. (anhydrous), 140° C. crystals. Fuller gives 160°-170° C. Soluble in alcohol and chloroform and in hot water, slightly in cold water, and solution is neutral and lævorotatory, almost insoluble in ether and benzene. It forms no crystalline addition compound with chloroform, but, like colchicine, it dissolves in acids, alkalies, and alkaline carbonates, with a yellow color; also, like colchicine, it does not combine with acids to form salts. Although Oberlin, who first obtained it (1856), thought it pre-existed in colchicum, Zeisel says it is only formed by decomposition of colchicine, produced as a result of hydrolysis on extracting the drug with acid menstrua. It has much the same physiological action as colchicine, but, according to Fuehner (1913), is very much less toxic.

Tests and Reactions of Colchicine.

The usual slab color reactions given with strong acids need not be mentioned, nor the precipitates given with the usual alkaloidal reagents, such as Mayer, Thresh, Marmé, except that arseno-, silico- and phospho-tungstic acids all give yellow precipitates, and that platinic chloride gives no precipitate, although gold chloride gives a crystalline double chloride. Bromine water also gives a yellow precipitate soluble in ammonia to an orange liquid. Colchicine is so readily converted into colchiceine by acids that some of the reactions attributed to colchicine itself are probably due to its decomposition product. Ferric chloride, *e. g.,* gives a dark green with colchiceine. When, therefore, $FeCl_3$ requires the addition of conc. HCl to give the green color with colchicine itself as in Fabinyi's colorimetric method, we may assume that colchiceine is formed. Colchicine solutions give no color with $FeCl_3$ in the cold, and, on heating, a brownish red. An alcoholic solution of colchicine gives with $FeCl_3$ solution a garnet red. Ammonium vanadate gives a reddish yellow with colchicine, but a dark purple color with colchiceine. If a mixture of 5 drops each of an aqueous solution of colchicine, fuming HNO_3 and $FeCl_3$ solution be heated to boiling, a yellow solution is formed, changing to olive green, and if the above mixture be shaken with chloroform the latter is colored ruby red and the aqueous solution remains green. Fuehner (1910) gave the following test for the toxicological detection of colchicine. 5 cc. of the solution are heated on a boiling water

bath for half an hour with 5 drops 20 per cent. HCl. On then adding 3 to 5 drops $FeCl_3$ solution a green color is produced. On cooling and shaking out with chloroform the latter is colored yellowish to permanganate red. 0.005 gm. will give the red tint; the green color is more sensitive, but alone, is not sufficiently characteristic. It was noticed in applying the tests for colchicine that (1) Ether containing SO_2 gave a canary-yellow precipitate, which reaction may also be used as a test for the presence of SO_2 in ether, (2) that ligroin or petroleum spirit precipitated from alcoholic solution a white compound, which at 100° C. reverted to the ordinary yellow variety, (3) that carbolic acid, cresol, and thymol as well as tannic acid and salicylic acid, gave precipitates with colchicine, and that, as all these are phenolic substances, it is evidently with the phenolic and not with the carboxylic grouping that the colchicine combines in forming the so-called tannate and salicylate, so that these compounds are *not* true salts. Picric acid gives no precipitate, but on adding acid a resinous mass is produced. Colchicine is used in relieving the pain in the acute manifestations of gout. It is thus a natural pain-relieving drug principle, and this analgesic action is associated with the presence in the molecule of an amido-acetic grouping, just as in the artificial analgesics, acetanilide, phenacetin and phenazone or antipyrine, which are used to relieve the acute pain of neuralgia and sciatica, and all of which also resemble colchicine in not combining with acids to form salts.

Preparation of the "Salts" of Colchicine.

The salts of colchicine, if they exist, are extremely unstable, being decomposed by water. Thus colchicine may be extracted from an acidulated solution by chloroform.

Colchicine Salicylate.—This compound is used medicinally and may be prepared by moistening a mixture of 20 parts of colchicine and 7 parts of salicylic acid and drying. It is a dark yellow, amorphous powder, easily soluble in alcohol, slowly soluble in water, and was found to have no sharp m.pt. The following experiments prove that if it is a salt, it is decomposed in solution:—(1) 0.2 gm. was dissolved in 20 cc. water and shaken in a separator with 10 cc. ether (colchicine is only slightly soluble in ether, salicylic acid 1 in 2). The separated ether layer was washed twice with 10 cc. of water and evaporated. The residue consisted entirely of salicylic acid. (2)

0.2 gm. was dissolved in 15 cc. water and shaken with 10 cc. chloroform. The free salicylic acid, precipitated in the water layer. The separated chloroform was washed twice with 30 cc. water and evaporated to dryness. The residue consisted entirely of colchicine and gave no purple with $FeCl_3$.

Colchicine Tannate.—This is the only stable salt, and is prepared by adding tannic acid solution to a solution of colchicine. Care must be taken not to add excess of tannic acid, as this precipitate dissolves in excess. It is a grayish, amorphous powder, insoluble in water, but soluble in weak solutions of alcohol and in hot water.

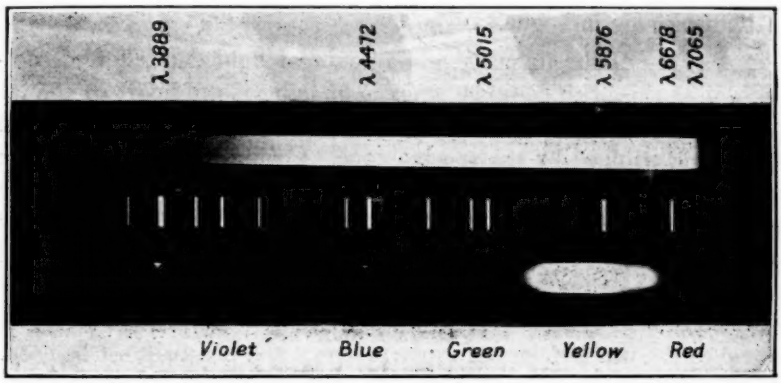
SCIENTIFIC AND TECHNICAL ABSTRACTS

COLD LIGHT.

All our artificial methods of illumination are dependent in the last analysis upon the combustion of hydrogen and carbon, except where water-power is the source of the energy. In ordinary practice the percentage of energy manifested as light is small, the bulk of the radiation being heat. A cold light is a very desirable product, for not only will economy result, but in certain applications, as in lantern projection and photomicrography the heat of the powerful lamps that are needed is a very serious objection. Sources of light low in heat rays are not unknown, but as yet no practical use has been made of them, and only limited studies as to their power and nature. Among the most common forms of such light are the emissions by living organisms and phosphorescence of mineral substances. The glowworm and firefly are familiar examples of the former, and the light emitted by phosphorus is a well-known instance of the latter. The "fox-fire" often seen on rotting wood is doubtless largely, if not entirely, due to minute organisms. We have also the glow of radioactive substances as seen on the dial of watches, which is, however, too feeble to serve as a radiant illumination.

The glow of phosphorus is due to oxidation, but it is remarkable that it is prevented by small amounts of substances which seem to have no specific chemical relation to the element. Lord Rayleigh has

lately published some researches on the subject. Camphor, ammonia and pear oil are among the most active restrainers of the glow yet found. Some hydrocarbons are also effective. Water vapor promotes the action up to a certain amount, beyond which it interferes. Moderate drying of the air in which the phosphorus is exposed produces a steady glow. Rayleigh's investigations show that the action is not by a wave of oxidation passing from one point to another in the vapor as has been supposed, but that the action is more recondite, being due to the formation of nuclei somewhat similar to the effect of a small crystal of a substance propagating crystallization in a supersaturated solution of the same substance. The inhibiting substances are supposed to be capable of associating their molecules with the nuclei and thus preventing the propagation.



Spectrogram of fire-fly light (lower spectrum), carbon incandescent electric lamp light (upper spectrum), helium vacuum tube (middle spectrum).
—*Courtesy of The Franklin Institute.*

Rayleigh's studies did not include an examination of the spectrum of the glow, but an interesting study of the light of the glow-worm and firefly has been made by Dr. Herbert E. Ives, and recently published in the *Journal of The Franklin Institute*. These animal glows are, without doubt, due to chemical action, presumably oxidation. They often seem feeble, but this is on account of the small area in action. Ives made quantitative determinations of the light of common luminous insects and also a spectroscopic study. The following is an account of the more important results obtained by him.

The measurements were in "lumens per square centimeter," a datum that is purely physical and need not be discussed here. He describes his methods in detail. The large Jamaica firefly gives out a light which was estimated by Pickering to be 0.004 candle. This is a flash, not a steady emission. The larva of the firefly has a steady glow which is sensibly equal to the flashes of the insect. Compared with a tungsten filament or the typical sky, the light from these glowing masses appears small. This does not prove that it is too small for use. To determine whether the light is or not applicable as an illuminant it is necessary to make quantitative tests. Dr. Ives finds as a result of extended experimenting under very ingeniously arranged apparatus that while the light of the glowworm is not capable of use in locomotive headlights or for intense local lighting, it is, as it stands, of an intensity sufficient for use in comparison with some methods of lighting now in vogue.

A study of the intensity and amount of light emitted, and comparison of this with common sources of light, is only part of the investigation. The composition of the light is important. This can only be determined by the spectroscope. Owing to the fact that the human eye has only a range of percepion from violet to red, while light rays are frequently emitted beyond both these limits, photography must be employed for a complete study of the spectrum of any source. Panchromatic plates having a range well above the violet are easily made and these were employed in the investigation. To obtain a full record of the ultra-violet light quartz lenses and prisms must be used. By placing a flashing firefly before the slit of a small quartz spectroscope, a photograph of the spectrum was obtained which shows that the light (practically yellowish green) is limited to a narrow area in the visible spectrum. There is no evidence that any rays beyond human vision are emitted, but the light is just that which gives the highest sharpness in discerning detail, in which respect it surpasses any artificial light now available. Being, however, limited in range of color and lacking blue, green and red, it would give a somewhat ghastly tint to all objects, like the illumination produced by burning an alcoholic solution of salt. It is essentially a "cold" light, for while in our ordinary illuminants light is a by-product of heat dissipation, in the firefly heat is a by-product of light production.

H. L.

THE YIELD OF GLUCOSE FROM COTTON CELLULOSE.—Irvine and Hirst (*J. C. S.*, 1922, vols. 121-2, 1885) made an investigation with a view of determining the reason that the usual processes for converting cellulose into glucose do not give the yield that would be expected upon the theory that cellulose is composed entirely of glucose units. Previous investigations by Irving and Soutar in 1920 had given a yield of 85%. The experiments now reported were carried on upon the same general principles as the former ones, but a notable improvement was obtained by conducting the acetolysis in the manner suggested by Barnett (*J. S. C. I.*, 1921, v. 40). An excellent yield of cellulose triacetate of uniform quality was obtained, and as no sugar was found in the washings, much work was eliminated. The conversion of the acetate into methylglucoside was performed in many ways, but for quantitative work of this kind, the best results were obtained by digesting small amounts of the compound with methyl alcohol containing about 0.75% hydrogen chloride. The use of an autoclave was abandoned, the whole procedure being carried out in sealed tubes, containing about 4 grams of the triacetate. After about seventy hours' action only a trace of solid matter remained, and the solution, which was faintly yellow, contained alpha- and betamethylglucosides in equilibrium. The specific rotation of the liquid ranged within 107-108°, the calculation being based on the assumption that the whole of the cellulose has been converted into the methylglucoside.

Each of the reactions involved has been carried out on numerous occasions and by independent workers. With practice and experience the yields have been regular, and the following figures are submitted as the average of concordant experiments.

Cotton cellulose	100	parts
Cellulose triacetate	117	"
Methylglucosides	114.1	"
Equivalent of glucose	106	"

The yields are in each case about 99.5% of the theoretical.

H. L.

MANUFACTURE OF CARBON DISULPHIDE IN THE ELECTRIC FURNACE.—George A. Richter, of the Research Department of Brown and Company, Berlin, N. H., contributed to the forty-second general meeting of the American Electrochemical Society a paper embodying

the results of experiments on the production of carbon disulphide by the Taylor process, although differing somewhat from the original form of that process. Large-scale production is based upon the direct action of the two elements at a temperature ranging from 600° to 1000° C., at which temperatures the sulphur is, of course, in the form of vapor and the carbon an incandescent solid. Not all forms of carbon are admissible; anthracite, gas coke and other dense forms cannot be used. Good grades of willow or birch charcoal are among the best, especially those with a low ash content. The materials should be as dry as practicable. Water vapor will form hydrogen sulphide and other sulphur compounds. The charcoal should be well burned. The mechanical arrangements are described in the article, and the thermal data are presented in much detail. The conclusions are that a comparatively recent process for the manufacture of carbon disulphide has been devised and actual plant data indicate that the units operate with reasonably fair thermal efficiency.

H. L.

Manufacture of Vanillin by Electrolysis.—In 1895, a German patent was issued for a process for producing vanillin by subjecting isoeugenol to an electric current, the vanillin being formed by oxidation and appearing at the anode. The process was described in some detail, consisting essentially in placing in the anode cell a 15% solution of isoeugenol in an excess of sodium hydroxide, the cathode cell being charged with a 15% solution of sodium hydroxide. A current of about 5 volts and 6 amperes was recommended. The course of the action is followed from time to time by withdrawing small portions and testing for vanillin. A temperature of about 60° C. is advisable. When the action has progressed well, the anode liquid is shaken with ether which dissolves the vanillin and any unchanged isoeugenol. The vanillin is recovered by shaking with acid sulphite, and this compound decomposed in the usual way.

Notwithstanding the specific claims of this patent, Alexander Lowy and Catherine M. Moore, of the Department of Chemistry, University of Pittsburgh, found by careful experiments that the results stated cannot be obtained. Their work was communicated at the forty-second general meeting of the American Electrochemical Society in September last. All attempts to get an appreciable yield of

vanillin failed. Vanillin, itself, was found to oxidize readily, and even if produced in the process will be at once converted into other substances. Experiments were also carried out in which sulphuric acid was used as the electrolyte, but also failed. In all the experiments a resinous substance was obtained. Statements are made in textbooks that vanillin can be obtained electrolytically from isoeugenol, but such statements are not borne out by the investigation. If isoeugenol can be so converted, it must be under conditions different from those called for in the patent.

H. L.

PREPARATION OF PERCHLORATES BY HEATING CHLORATES.—Mathers and Jones, respectively of the Indiana State University and the Research Department of the Roessler and Hassler Chemical Company, St. Albans, Vermont, have investigated the comparative yields of the electrolytic and direct heating processes for obtaining perchlorates. They failed to find any method by which the yield in the heating process can be increased over that heretofore obtained. Additions of different substances were made in hopes to establish a catalytic effect, but none served the purpose, and most decreased the yield. The maximum yield was obtained by heating from 1 to 50 grams of potassium chlorate at from 480° to 560°C. for from 30 to 60 minutes. The yield was about 55%. Sodium chlorate gave lower results, and several other chlorates were largely decomposed to chloride. The use of perchloric acid for electrolytic purposes makes its production important.

H. L.

ABSTRACTS OF CERTAIN PAPERS PRESENTED IN THE SCIENTIFIC SECTION OF THE AMERICAN PHARMACEUTICAL ASSOCIATION.

THE OCCURRENCE AND FORMS OF CALCIUM OXALATE IN OFFICIAL CRUDE DRUGS. EDGAR T. WHERRY AND GEORGE L. KEENAN, BUREAU OF CHEMISTRY.—About seventy-five of the drugs listed in the U. S. Pharmacopœia, ninth revision, and the National Formulary, fourth edition, are stated to contain crystals of calcium oxalate. A study of these crystals by the immersion method under the petro-

graphic microscope has shown that the larger part of the crystalline material heretofore described as being calcium oxalate has been confirmed as such, while in a few instances, *e. g.*, the leaves of Belladonna and Hyoscyamus, the crystalline material has been found to be a substance other than calcium oxalate monohydrate. With the aid of this method, the identification of crystalline material as calcium oxalate monohydrate in powdered drugs should be readily accomplishable.

Some Interesting Medicinal Plants of Bolivia.—The total number of plants possessing medical interest collected on the Mulford Biological Exploration of 1921-1922 was large. Many of the specimens are wanting in flowers or fruit, or both, and their identification will be difficult and slow. The present paper deals with but three groups:

1. Coto Bark and its Substitutes.
2. Cocillana Bark and its Substitutes and Congenors.
3. Vilca Bark.
4. Bystropogon as a Source of Volatile Oil.

In the case of numbers 1 and 2 the object is to indicate the distinctions among the members of each group, and the methods of identification, not only of the crude drugs, but of their galenical preparations. No. 3 is believed to be unknown to science and is here described. No. 4 discusses only the identity and distribution of one of the species, the oil of which has been subjected to investigation.

In this paper, taxonomic and general facts are discussed. The histology and chemistry of the drugs will be discussed by my colleagues.

H. H. Rusby.

On the Chemistry of the Seeds of Datura Stramonium. By Isao Nishimura and Edward Kremers. Abstract.—The breeding of *Datura stramonium* for alkaloid is an important problem in the cultivation of medicinal plants, but it is only one of numerous problems associated with the economic aspects of the culture of this plant. Some of these problems have been alluded to at previous meetings. Suffice it here to point out that the seeds, which constitute an

important percentage of the crop, possess an economic value as well as scientific interest. Whereas the endosperm contains fatty oil—that of the immature as well as that of the mature seeds was examined—the seed coating contains not only a relatively high percentage of alkaloid, but a strikingly fluorescent principal as well. The alkaloidal content of the germinated seeds was also ascertained.

DIETHYLPHTHALATE. By J. A. HANDY AND L. F. HOYT. ABSTRACT.—A brief historical review of the literature, together with a discussion of the practical use of Diethylphthalate as a modifying agent for specially denatured alcohol approved for use in the manufacture of high grade perfumes and toilet waters.

The physical and chemical constants of six standard American brands and two foreign brands are given, together with the technique involved in their chemical assay.

The following data shows the range of variation for all the different samples:

Specific Gravity /15.6° C. ..... 1.1218 to 1.1261
Refractive Index /20 ..... 1.5008 to 1.5020
Optical Activity /20 .....(—) 6°, 26.4′ to (+) 0°, 6.2′
Free Acidity as Phthalic Acid ..... .017 to .105 per cent.

Saponification (mgm.KOH per gm.) 500.82 — 504.16 = 99.16 to 99.82 per cent. Ester.

Saponification No. (Corrected for free acidity) 99.09 to 99.78 per cent. Ester.

Boiling Point (29.33″ Barometric reading), 295° C. (average temp.).

A preliminary report will be made on some data for vapor pressure curves for pure Diethylphthalate as well as mixtures of two and one-half, and one per cent. solutions of Diethylphthalate in alcohol.

DETERIORATION OF THE TINCTURE OF DIGITALIS. CHARLES C. HASKELL, D. S. DANIEL, and G. S. TERRY. ABSTRACT.—When the preparations are assayed by the frog or guinea-pig method, there appears to be a definite loss in the activity of tinctures of digitalis within comparatively short periods of time.

No evidence has been published to justify the opinion that tinctures of digitalis shows any loss of strength in reasonable lengths of time when the tests are carried out on cats; rather, it would seem that the tincture, as judged by this method, is practically stable.

The experiments presented in this paper support the view that the majority of samples of tincture made with 70% alcohol undergo little or no change during five years.

The explanation for the different results obtained by the frog and guinea-pig method on one hand and the cat method on the other in all probability lies in the fact that with the lapse of time a change takes place in the tincture which renders the preparation more difficult of absorption from the lymph sac of the frog, but, apparently does not render it more difficult of absorption from the alimentary tract of the cat.

THE QUANTITATIVE DETERMINATION OF SPARTEINE IN TABLETS. BY PAUL W. JEWEL. ABSTRACT.—The investigation was carried out with a view to developing a method for the quantitative determination of Sparteine, which would be rapid and simple and which could be depended upon to give accurate results.

Sparteine is only slightly volatile at 100° C., the loss being only 3.1% after an hour's heating at this temperature, 1.0% more after half an hour, and at the end of seven nours' continual heat 2.5% additional. The use of a small amount of heat does not affect the accuracy of the gravimetric determination, and the alkaloid is not lost through volatilization in the vapors of chloroform. This is further substantiated by the fact that the quantitative determination of pure Sparteine Sulphate showed a recovery of 99.3-99.5%.

The U. S. P. and Jorrisen qualitative tests are very distinctive and considered to be preferable to that of E. H. Grant.

Sparteine Sulphate U. S. P. is monoacidic to methyl red and to phenolpthalein and may be titrated direct with N/50 sodium hydroxide, using these indicators, phenolpthalein being preferable to methyl red.

MEDICAL AND PHARMACEUTICAL NOTES

SOME NOTES UPON THE HAIR.—M. Sabourand, the eminent dermatologist, has pointed out the harmfulness of washing the hair with more or less concentrated solutions of alkaline bases (potassium, sodium, ammonium). This practice renders the hair, so treated, fragile; the ends become forked, ravelled and broken. Heating and curling produce disastrous effects upon the hair, the curling called "permanent" being particularly harmful. Bleaching with hydrogen peroxide is evil; the chemical and physiological action of this product deprives the hair of its elasticity. In the same manner he deprecates dyeing in general as injurious.

To cleanse the hair a very hot solution of borax followed with a hot decoction of soap bark is recommended. This treatment does not injure the hair, although it removes the fatty substances secreted to place a control upon narcotic exports.—(*Repertoire de Pharmacie.*)

W. H. G.

COCAINE TRAFFIC IN FRANCE.—A modification of the law governing the sale of narcotics is urged, the main points of which are as follows: Forbidding of residence in the country for at least five years for traffickers under pain of an imprisonment of from five to ten years; no legal delays permitted; fines greatly increased; the seizure and closing of shops or places where violations are conducted; closer surveillance at all frontiers and in the country; the creation of an international commission on narcotics; the authority to search premises of traffickers or addicts at any time, when the need is established.

It is thought that the place to combat the evil most successfully is at the source of supply, it being alleged that nearly all the cocaine is produced by two or three works in Germany, no obstacle being placed upon the exportation.

There is hope that the French Government can compel Germany to place a control upon narcotic exports.—(*Repertoire de Pharmacie*).

W. H. G.

Estimating Urinary Chlorides.—M. Meillère states that he employs a modification of Mohr's method, consisting of pouring the urine into a solution of silver nitrate—instead of pouring the silver nitrate solution into the urine. One can operate with a simple tube of 20 to 25 cm. in length, of a capacity of 20 to 25 cc. of liquid, divided into cc. and tenths of cc.

He introduces into this tube 10 cc. of a solution containing 29 gm. 09 of silver nitrate per litre, of which 1 cc. corresponds to 1 c. gm. of sodium chloride; then is added one drop of a saturated solution of potassium bichromate, producing the brick-red color of silver chromate. The urine is now poured very carefully in a measured quantity, shaking the tube and keeping it well closed until the color disappears—at the moment of discoloration, the quantity of urine added will contain 10 c. gm. of chlorides.

Let n be the quantity of urine poured into the tube—one litre of urine will contain a quantity of chlorides equal to $100/n$.—(From *Tribune Medicale*, through *Repertoire de Pharmacie*.)

W. H. G.

NEWS ITEMS AND PERSONAL NOTES

Hanbury Medal Award.—We learn with pleasure that the Hanbury Gold Medal, created to commemorate the work of this illustrious English naturalist, has recently been awarded to M. Perrot, Professor of Materia Medica in the faculty of the Paris School of Pharmacy.

No one is better qualified nor fills more perfectly the conditions of the founders of the Hanbury Medal than Professor Perrot, whose labors are known to scientists throughout the world.

M. Richard Appointed Professor.—M. Richard has been appointed Professor of Pharmacology on the Faculté de Medicine de Paris, succeeding M. Pouchet, retired.

THE BOTANICAL SOCIETY OF PENNSYLVANIA.—On Saturday, September 23, the Botanical Society of Pennsylvania visited the Botanical Gardens of the Philadelphia College of Pharmacy and Science near Glenolden, Pa. The party, numbering thirty-five, was under the leadership of Professor Youngken, of the college, who exhibited about 300 species of medicinal and ornamental plants now thriving in the gardens. Intense interest was shown by the party and particularly toward such rarely found specimens in Pennsylvania as the Leprosy plant (*Taraktogenos kurzii*), the Saw Palmetto (*Sabal serrulata*), *Atropa physalloides* and the Cotton Plant (*Gossypium Barbadense*).

FLUCKIGER MEDAL AWARDED TO THE AMERICAN, DR. F. W. POWER.—The Flückiger Medal has to date been awarded to one Englishman (Holmes), one German (E. Schmidt), one Frenchman (Heckel), one German residing in Switzerland (Hartwich), and two Austrians (Vogl and Mœller). The Swiss Apothecary Association, whose turn it is this year to make the award, has, by direction of the curatorium of the Flückiger Foundation awarded the medal to an American, Dr. Frederick Power.

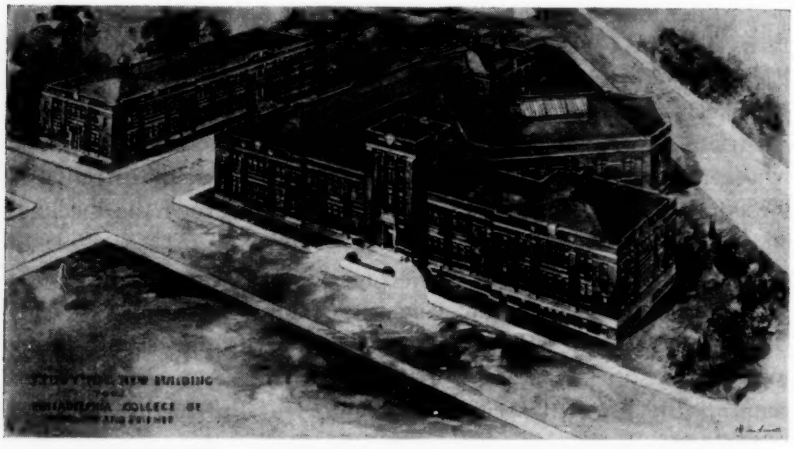
Frederick Power, who at the present time directs the biochemical division of the Bureau of Chemistry of the Department of Agriculture of the United States, which is devoted to the scientific study of plant constituents, was prior to his return to America, his native country, director of the scientific laboratory of Burroughs-Wellcome, in London. During his first residence in America he published many articles, most of which were on essential oils. These earned for him the offer to become chief of the Wellcome laboratories, where, provided with abundant material and aided by numerous assistants, he conducted a large number of valuable investigations of medicinal plants, all of which are characterized by their thoroughness. He succeeded in isolating and identifying a number of new and interesting substances.

Power is one of Flückiger's scholars and for a time was his assistant. About thirty years ago he translated into English Flückiger's *Grundlagen die Pharmakognosie* (Fundamentals of Pharmacognosy).

PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE NEWS NOTES

Record Attendance.—Over 700 students are registered in the College when it opened Monday, September 25, 1922. More than one hundred applicants for the First Year Class could not be admitted because of limited accommodations.

Quarterly Meeting of College Members.—The quarterly meeting of the members of the College was held on Monday, September 25, 1922. The "College" is an incorporated body which has conducted



Study for New Building for the Philadelphia College of Pharmacy and Science.

the teaching institution for more than one hundred years (since 1821) and published a scientific journal (*The American Journal of Pharmacy*), now of international reputation since 1826.

History of the First Century.—An advanced copy of the Centennial History of the College was shown at the meeting by the editor, Joseph W. England. This volume has been in preparation for about two years, as a feature of the Centennial celebrations and the editor has been assisted by Dr. Ellis Paxon Oberholtzer, Dean LaWall, Dean Stermer and others. There will be over 500 pages of history,

200 illustrations, and, in Part II, more than 9000 biographies of graduates of the College and Medico-Chi, which is now affiliated. This book has already had a large advanced sale.

New Site and Buildings.—President William C. Braisted made the gratifying announcement that the committee appointed by the Board of Trustees last May to work out a program for expansion and development had held many conferences during the summer and made their report at the September Board meeting. Their program received the unanimous endorsement of the Board, and the completion of the first step was already an assured fact.

This planning committee consisted of:

Samuel P. Wetherill, Jr., Chairman
Russell T. Blackwood
William C. Braisted, M. D.
Otto W. Osterlund
Frank R. Rohrman
William L. Cliffe
Milton Campbell
Charles H. LaWall
Benjamin T. Fairchild
George D. Rosengarten, Ph. D.
George B. Evans
Horatio N. Fraser
E. Fullerton Cook, Secretary

The complete program embraces four objectives:

I. Larger and more suitable location.
II. Modern, newly equipped and commodious buildings.
III. An Expansion Trust Fund.
IV. Therapeutic Research Laboratories.

On October 2, the College officials took over the title to the property at Forty-third and Woodland Avenue for the site of the new College buildings. The price was $60,000 and the lot has been secured through the generosity and assistance of the President, the officers, the Trustees and Faculty.

The campaign for funds for the buildings and expansion will be immediately launched under the direction of the President and the committee of the College.

The Therapeutic Research Institute which will co-operate with the medical colleges of Philadelphia and established hospitals, is an important part of the College program for its second century.

Admiral Braisted, Surgeon-General of the United States Navy throughout the World War, has devoted much time during the last two years towards the establishment of the Gorgas Memorial in Panama, an institute for the study of tropical diseases, to commemorate the monumental services of General Gorgas.

Dr. Braisted has now moved to Haverford, a Philadelphia suburb, and will actively promote the expansion program of the College and also the Therapeutic Research Institute, which so properly belongs to Philadelphia, with its splendid record for service in the medical sciences.

Campaign Office Opened.—An office has been opened in the College, at 145 North Tenth Street, for the conduct of an active campaign for new buildings and an endowment fund. The gift of the new lot is tangible evidence that those who are locally active in College affairs believe in the expansion program and have confidence in the support of the Alumni and friends of the College.

University of Pennsylvania Co-operation.—Arrangements have been made with the University of Pennsylvania to conduct the selling and advertising classes in the Business Administration course of the College of Pharmacy. These courses will be under the direction of Dr. Hess, a member of the Faculty of the Wharton School.

When the College moves to its new site only three squares from the University, some of the economic policies recently referred to by acting-Provost Penniman, of the University, can be admirably developed. That this is practical and that there exists this friendly relationship between these two older teaching institutions in Philadelphia is evidenced by the arrangements just announced.

Free Public Science Lectures.—The second series of free public lectures, by members of the Faculty of the College has just been announced. These lectures will be held on Wednesdays, at 8.15 P. M., beginning October 11, at 145 North Tenth Street. The subjects are:

"Chemistry as an Aid in the Detection of Crime," Dr. Henry Leffmann.

"Corn and Its Products," Prof. Freeman P. Stroup.

"The Story of Glass," Prof. J. W. Sturmer.

"Vitamines," Prof. David Wilbur Horn.

"Bacterial Preparations in Common Use," Prof. Louis Gershenfeld.

"The Aluminum Age," Prof. Ralph R. Foran.

"The Making of Medicines," Prof. E. Fullerton Cook.

"The Cost of Patent Medicine," Dr. Horatio C. Wood.

"The New Alloys of Iron and Their Uses," Prof. Frank X. Moerk.

"Another Drop of Blood," Prof. Ivor Griffith.

"The Romance of Spices," Prof. Charles H. LaWall.

"Catalysis and Catalysts," Prof. Samuel P. Sadtler.

"Animal-Eating Plants," Prof. Heber W. Youngken.

"Explosives and Explosions," Dr. Henry Leffmann.

At the close of the series the lectures of this year will be published in book form.

Citizenship.—Recognizing the importance of stimulating the sense of loyalty and obligation as citizens, five lectures were given during last year's course on the subject of citizenship all students being admitted. This year, because of the greatest interest and benefit, the number of these lectures will be doubled and the speakers will be prominent publicists of Philadelphia and New York, men of inspirational power.

The following members of the faculty were in attendance at the meetings of the Pennslyvania Pharmaceutical Association at Buena Vista Springs, Pa.: C. H. LaWall, H. W. Youngken, F. P. Stroup, L. F. Cook, R. R. Foran, R. P. Fischelis, Paul S. Pittenger, E. J. Hughes and A. B. Nichols.

Those attending the meetings of the American Pharmaceutical Association at Cleveland, Ohio, were: Charles H. LaWall, H. W. Youngken, E. F. Cook, J. W. Sturmer, F. P. Stroup, Ivor Griffith, Paul S. Pittenger, R. P. Fischelis, Dr. F. E. Stewart, A. B. Nichols and Dr. Braisted.

The annual convention of the Beta Phi Sigma Fraternity was held August 21 and 22 at Buffalo, N. Y., at The Stuyvesant. About thirty-five delegates from the various chapters were present and the following officers were elected: Dr. Heber W. Youngken, Grand Councillor; Dr. Charles H. Abbott, of Buffalo, Vice Grand Councillor; Dr. Henry G. Bentz, of Buffalo, Grand Secretary, and John L.

Repton, of LeRoy, N. Y., Grand Treasurer. Applications for three new charters were passed upon.

Members of the Phi Delta Chi Fraternity attending the meetings of the American Pharmaceutical Association at Cleveland, Ohio, celebrated the occasion by having a dinner at which about thirty-five were present. Instructor Adley B. Nichols is Grand Vice-President of the national organization.

CORRESPONDENCE

American Journal of Pharmacy,
Philadelphia, Pa.

Gentlemen:

I beg to submit the following formulas for non-alcoholic elixirs, or more properly termed solutions, which are intended to replace the present alcoholic solutions dispensed under these names.

The definition of an elixir carries with it the understanding that such a preparation contains but small amounts of medicinal substances incorporated with alcohol, syrup, water and aromatics. The introduction of the Volstead Act makes it desirable, where possible, to dispense with the use of alcohol.

I believe there are many official preparations which now contain alcohol, but which would be better without this solvent, not only from an economical viewpoint, but also from a scientific viewpoint.

These formulas are submitted to demonstrate the possibilities of making non-alcoholic elixirs.

Elixir Lactated Pepsin.

(Equivalent of 40 grams of lactated pepsin to the fluidounce.)

Granular pepsin 1-3000	5 oz. 372 gr. (Avoir.)
Sugar	10 lbs.
Benzoate of soda	1 oz.
Lactic acid	8 fl. oz.
Glycerin	1 gal.
Flavoring mixture	2½ fl. dr.
Carmosine (water soluble aniline)	1 dr.
Water, to make	5 gals.

Elixir lactated pepsin, 80 grains to the fluidounce may be made with double the amount of pepsin.

Flavoring Mixture.

Oil Orange (Terpeneless)	1 fl. oz.
Oil Lemon (Terpeneless)	2 fl. oz.
Oil Nutmeg	1 fl. dr.
Oil Aniseed	2 fl. dr.
Oil Lemon grass	2 fl. dr.
Citral	3 fl. dr.

Rub 2½ fluid drams of oils thoroughly with the talcum and then add the dram of carmosine, then the benzoate of soda, add this mixture to 10 pounds of sugar in a 5-gallon receptacle and stir it thoroughly. Next add the lactic acid, pepsin and water, about three gallons, and let stand about twelve hours. To four 1-gallon well-wetted filters add a little powdered talcum and filter up to four gallons, then add the glycerine to completion.

Elixir of Iron, Quinine and Strychnine.

Iron and Quinine Citrate (Scale Salt)	10 oz. (Avoir.)
Sugar	10 lbs. (Avoir.)
Strychnine Sulphate	80 grs.
Sodium Benzoate	1 oz. (Avoir.)
Talcum	2 oz.
Flavoring mixture	2½ fl. dr.
Glycerin	1 gal.
Water, to make	5 gals.

In a wedgewood mortar rub the flavoring mixture with the talcum and benzoate of soda and about two quarts of water. Add this mixture to the sugar in a five-gallon container, then add the scale salt and stir all thoroughly. Dissolve the strychnine sulphate in about one quart of hot water and add this and enough water to make about four gallons; when all dissolved pour into into four or five one-gallon well-wetted filters which have added a little talcum in the bottom of the filter, and when four gallons are obtained add the glycerine for completion.

Respectfully yours,

GEO. H. COPELAND, Ph. G., Class 1888.

(Editorial Comment: The above formulas may be perfectly practicable and productive of elegant galenicals, but we doubt very much the advantage of substituting sodium benzoate for the alcohol,

which is now used as the preserving agent. In the first place, benzoate of soda is illegally used unless the label carries the legend of its presence in the bottle, and we have also been taught that benzoate of soda, in common with all other chemicals of its type, inhibits the peptic activity of the digestive ferment. It is also to be noted emphatically that the second formula is entirely at variance with the official product, and that the first formula differs markedly from the former N. F. digestive elixir. We doubt very much whether either of these non-alcoholic elixirs bears comparison with the present alcoholic product.)

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

October 6, 1922.

Editor, THE AMERICAN JOURNAL OF PHARMACY.

Dear Sir:

May I call your attention to a typographical error in the article by Dr. Leffmann in the September number of your JOURNAL which reviews work on the cryoscopy of milk reported in Bulletin 236 of this Station. On page 585, line 12, it reads "minimum of —0.5930°" whereas it should read "minimum of 0.530°."

As these limits are important, the accidental insertion of a "9" between the 5 and 3 is unfortunate and I judge you or Dr. Leffmann may wish to correct it in your next issue.

Respectfully yours,

E. M. BAILEY.

BOOK REVIEWS

A TEXTBOOK OF ORGANIC CHEMISTRY. By Joseph Scudder Chamberlain, Ph. D., Professor of Organic Chemistry, Massachusetts Agricultural College. 12 mo., pp. 959. Cloth, $4. Philadelphia, P. Blakiston's Son & Co.

The growth of chemical industries in the United States during the last few years, especially during the world's war, has created new interest in chemistry. This is especially true as to organic chemistry. In the book before us the author presents the subject in a sufficiently

elementary manner so as not to go beyond the grasp of the student in his first course in organic chemistry, and at the same time makes the text comprehensive in that it covers the entire field by taking up practically all the important groups of compounds.

We beg to call special attention to the classic arrangement of the text from which we will cite the following headings:

Part I. A—Cyclic Compounds: a, Simpler Saturated Compounds (Hydrocarbons of Saturated Series; Mono-substitution Products of Saturated Hydrocarbons; Oxidation Products of Alcohols); b, Simpler Unsaturated Compounds (Unsaturated Hydrocarbons; Mono-substitution Products); c, Poly-saturated Products (Poly-Halides, Cyanides and Amines; Poly-Hydroxy Compounds; Mixed Poly-substitution Products, Poly-Aldehydes, etc.; Carbohydrates, Amino, Acids and Proteins; Cyanogen, etc.; Carbonic Acid, Urea, Purine, etc.).

Part II. Cyclic Compounds: Sect. I. Carbo-cyclic Compounds: a, Alicyclic Compounds (Saturated and Unsaturated); b, Carbo-Cyclic Compounds (Benzene Series: Diphmyl and Related Compounds; Condensed Ring Compounds; Hydrogenated Benzene Compounds). Sect. II.: Hetero-Cyclic Compounds: a, Five-membered Rings; b, Six-membered Rings; c, Condensed Hetero-cyclic Compounds; d, Alkaloids. The contents alone occupy forty pages.

Besides all this the author furnishes twenty excellent tables, those on essential oils giving source and chief constituents. An excellent list of reference books is found at the end of the volume, besides an appendix containing a brief discussion of the separation, purification, identification, analysis and determination of molecular weight of organic compounds.

Chamberlain's Organic Chemistry is a valuable work which is also very useful to the pharmacy student as a textbook and to the pharmacist as a reference work.

OTTO RAUBENHEIMER, Ph. M.

CHEMISTRY AND ITS USES. By William McPherson and William Henderson, Professors of Chemistry at Ohio State University. 12 mo., pp. 447. Cloth, $1.60. Ginn & Co., Boston.

Both teachers and students have learned that the names McPherson and Henderson are good news on a title page. The authors

of "A First Course in Chemistry" have just published a new text entitled "Chemistry and Its Uses." Every teacher of chemistry realizes that the watchword of the present day is the practical rather than the theoretical, the application rather than the abstract principle, the pictorial rather than the descriptive. Just how far this tendency should be followed each author and each teacher must decide for himself. The volume before us represents the opinion of the present authors.

The book begins with the usual chapters on oxygen and hydrogen and gradually works its way up to organic chemistry. The 260 illustrations, including many short biographies of the pioneers and authorities in chemistry, help to arouse more interest in the study and elucidate the text. The book abounds in the practical applications of chemistry to the arts, industry and every-day life without sacrifice of the necessary basis of theory. The book is stimulating and instructive and is also well adapted for pharmacy students.

OTTO RAUBENHEIMER, Ph. M.

VITAMINS AND THE CHOICE OF FOOD. By Violet G. Plimmer, Associate of the Royal Sanitary Institute, and R. H. A. Plimmer, D. Sc., Professor of Chemistry, the University of London at St. Thomas's Hospital Medical School, etc. Royal Octavo, pp. 168. Cloth, $2.50. Longmans, Green & Co., London, New York, Bombay, Calcutta and Madras. 1922.

Recent scientific work has brought to light the indispensability of vitamins in nutrition. Their absence from the food is the cause of certain definite diseases, such as beri-beri, scurvy, rickets, pellagra, etc., to each of which the book devotes a separate chapter. Common errors in the diet may lead to an insufficiency of vitamins in the diet and the consequent ill-health.

The subject of accessory food-factors or vitamins has a special significance, as it marks the entry of biochemical research into the problems of health and growth. As yet chemical formulæ play no part. While the chemical nature of vitamins is unknown it is proven that some foods contain and other do not contain vitamins, and that faults in the diet are the cause of a number of diseases. The reviewer wants to call special attention to the appendix which contains

a table of six pages showing the distribution of vitamins in foods, which is taken from Report 38 of the Medical Research Committee.

We can heartily recommend this book to pharmacists as it is to their own interest to keep posted on this subject, so as to be able to answer daily questions about vitamins.

OTTO RAUBENHEIMER, Ph. M.

VAN NOSTRAND'S CHEMICAL ANNUAL. A Hand-Book of Useful Data for Chemists and Students. Edited by John C. Olsen, A. M., Ph. D., Professor of Chemical Engineering, Polytechnic Institute, Brooklyn. Fifth Issue, 1921, thoroughly revised and enlarged. Pp. 900. Flexibly bound, 5 x 7½ inches. $4. D. Van Nostrand Company, New York City.

The amount of chemical literature published each year has steadily increased at a very rapid rate. It has become more and more difficult for the busy chemist to gather from this mass of literature the facts which are of interest and use to him. The publication of the Chemical Annual was undertaken as an attempt to overcome this difficulty, at least in part. Professor Olsen, a recognized authority on chemistry, is to be congratulated on this undertaking, which has proven a success.

Recognized as an essential tool that belongs at the elbow of every chemist, this book has already passed through four large edition.

The new 1922 issue is greatly enlarged, thoroughly revised, corrected and carefully indexed for quick reference,—a bigger, better book than before.

One hundred twenty-five complete tables that a chemist constantly uses in his daily work are included in it—the tables of physical and chemical properties of elements and compounds, tables on the calculation of volumetric analysis, on weight equivalents, specific gravity, thermochemistry, stoichiometry, vapor tension, etc., and with each table is a set of directions for its use.

The referee begs to call special attention to the list of the more important books which have been published in America, England, France, Germany and Switzerland since October, 1917. This list

comprises 84 pages and also includes books on pharmacy, pharmaceutical chemistry and history of pharmacy and chemistry.

A new feature of the new Annual is the inclusion of a few pages of cross section paper which will be found very useful for notes, data, etc.

We can fully endorse Van Nostrand's Chemical Annual, as it supplies in convenient form the information which chemists, pharmacists and students use daily, but which cannot be retained in memory.

OTTO RAUBENHEIMER, Ph. M.

TRANSACTIONS OF THE COLLEGE OF PHYSICIANS. Third Series, Vol. XLIII. Philadelphia, 1921.

For many years this volume, a record of the transactions of a unique and conservative society, has regularly come to our office. This volume contains the papers read before the College from January, 1921, to December, 1921, inclusive. A pathetic reminder of the frailty of the thread of life comes to the reader of Mr. Howard Fussell's memoir of James Tyson. Dr. Fussell read the memoir before a meeting of the Fellows early in the year 1921, and paid a pleasant tribute to the memory of that grand old teacher of clinical medicine. When the leaves were dropping to the ground with the coming of the chill days—in the same year—the reader of the memoir himself passed on to the *bourne whence no traveler returneth.*

A variety of medical subjects are well treated and adequately portray the trend of medical progress particularly along the lines of industrial medicine and endocrinology.

Dr. Newbold's excellent lecture on the Voynich Roger Bacon manuscript is printed in full and is agreeable reading to other than students of medicine. An interesting bit of information points to Bacon as antedating the Dutch Draper in his use of the telescope and microscope.

I. G.

A Century of the United States Pharmacopœia 1820-1920, Liquor Potassii Arsenitis. By H. A. Langenhan. Part of thesis submitted for the degree of Doctor of Philosophy, University of Wisconsin, 1918. Bulletin of the University of Wisconsin. Serial No. 1153. General Series No. 936.

This thesis of fifty-seven pages is a comprehensive study of an arsenical preparation which has been used continuously in medicine for nearly one hundred and forty years, and which, before its analysis and professional use by Dr. Thomas Fowler, an English apothecary physician of the latter part of the eighteenth century, had originally appeared as a quack remedy entitled "Tasteless Ague or Fever Drops."

Besides the inclusion of a brief history of arsenic therapy, and a thorough study of the chemistry of the hydration of arsenic trioxide, considerable space is given to the pharmaceutical nomenclature of the preparation, and the varying formulas which have been used since the original letters patent were granted in 1781 to Thomas Wilson, of Snow Hill, London.

The formula of the patentee called for the calcined ashes of common centaury (which furnished potassium carbonate), the "flowers" which were obtained by subliming cobalt (an arsenical pyrites), and Red Saunders, all of which were to be boiled together for four hours, no quantities being stated in the patent.

The completeness with which the subject has been considered makes the monograph a valuable addition to any pharmaceutical library, and it makes interesting reading for any one who is interested in pharmaceutical research.

C. H. L.

Origin and History of All the Pharmacopœial Vegetable Drugs, Chemicals and Preparations, With Bibliography. Volume I. Vegetable Drugs. By John Uri Lloyd.

This buckram bound volume was prepared under the auspices of and published by the American Drug Manufacturers' Association, and was printed by the Caxton Press of Cincinnati, Ohio.

The book contains 356 pages devoted to historical miscellany concerning upward of seventy official drugs. Following this is a bibliography of more than 60 pages and an extensive index of both

names and subjects. The subject matter of the book is somewhat disappointing. Instead of containing complete historical monographs concerning the drugs as the title would indicate, the articles concern themselves mainly with the history of the therapeutic uses of the drugs. There is also lacking a definite plan of selection or arrangement of the subject matter.

Another disappointing feature of the book is the incompleteness of its scope. This is not the fault of the author who explains in the preface that he was restricted to the drugs which were official, in the Eighth and Ninth Decennial Revisions of the United States Pharmacopœia. It would have been a great improvement to have made it include all of the vegetable drugs which have been official since the first U. S. P. was issued.

Still another surprise awaits one who uses the book for historical reference purposes when he notes the absence of information relating to the active principles of many of the important drugs.

An historical article on cinchona, for instance, may hardly be considered as complete, which makes no mention of the discovery of the alkaloids and their subsequent replacement of the drug in medical practice, to a large extent. Again, under oil of gaultheria we find no record of the work of Procter or of Cahours in establishing the chemical composition of the oil.

In spite of these evident defects, which are probably due to the critical illness of Doctor Lloyd at an important stage in the preparation of the work, the work contains a large amount of valuable information of its kind, and the style of some of the longer articles is attractive from the literary standpoint.

C. H. L.